ONTARIO FIELD CROPS
RESEARCH AND SERVICES COMMITTEE

2002 ANNUAL REPORT

TO

ONTARIO AGRICULTURAL SERVICES
COORDINATING COMMITTEE

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Executive Summary

The Field Crop sector is a dynamic industry that continues to evolve and change. Cropping patterns are changing in demand to economic pressures, new technologies are being introduced and adopted rapidly and the producer (industry) is shifting more focus to consumers as their primary customers.

The role of the Ontario Field Crops Research and Services Committee and it's eight constituent subcommittees, set against that background of change, is to recommend strategic research and service directions to improve the efficiency of crop production in Ontario and to improve the competitiveness of, and opportunities for, Ontario agriculture in world markets. The major role that industry plays on these committees is essential in this process.

The 2002 Report continues to support the strategic directions for the field crop sector established in 2001. Research and services priorities encompass 5 broad themes, which are life sciences, food quality and safety, environmental sustainability, rural economic development and competitiveness. All priorities whether specific to commodities or disciplines address one or more of these themes. Specific research priorities and service priorities are grouped under the following headings:

Research Priorities

1. **Agronomic Systems and Environmental Stewardship.**
   Research leading to production systems and their components which enhance competitiveness, food quality and safety and environmental sustainability.

2. **Innovative and enhanced germplasm development and utilization.**
   This section will include crop breeding, performance evaluation, physiology and the development of new molecules, gene discovery, genomics, and bioinformatics to produce knowledge and materials to advance the industry.
3. **Market Responsiveness**
   Research strategies to address market development, new product development, food safety and enhancement.

Service Priorities

1. **Efficient and effective technology transfer.**
   Development and implementation of strategies to ensure the verification and uptake of appropriate technological advancements by the field crop sector.

These core areas are detailed in the section on Strategic Directions where specific research/service recommendations are chronicled. These recommendations represent the areas of research and technology transfer that FCRSC considers essential to the strengthening of the field crop industry in Ontario. Within each core area are commodity and pest management specific priorities. Activity is documented in each area, and rate of progress, industry needs and potential for success should dictate the shifting of resources within and across these priorities.

The 2002 report of the Ontario Field Crops Research and Services Committee provides an overview of the status of the field crop sector in Ontario including the identification of current issues facing the industry and the strategic directions and priorities for research and service.

Over the last twenty years, acreage of field crops in Ontario has been dominated by corn, soybeans and forages (Fig. 1). The drought of 2001, which severely compromised soybean yields, appears to have resulted in a shift away from soybeans to cereals, corn and pulse crops in 2002 (Table 1). Winter wheat continues to be the dominant cereal crop although there has been a four-fold increase in acres seeded to spring wheat since 1992. Favourable environmental conditions in 2001/2002 resulted in excellent wheat yields for the 4th year in a row. Although yields were greater than in 2001, corn and soybean yields were again below long-term averages as a result of mid-summer drought conditions, particularly in the southwest of the province. Green soybean seed at harvest caused considerable dockage for some producers. Those areas that were the driest during the latter part of seed maturation had the highest levels of green beans. This problem resulted in grade discounts, the downgrading of a large percentage of Identity Preserved soybeans, and difficulty meeting export obligations. Fall forage inventories varied across the province depending on local summer rainfall patterns. Forage harvests were delayed by dry early season conditions, which influenced growth and development. Where inventories were low, late fall harvests occurred which may reduce winter survival of established plants. Corn silage was also extremely variable in yield and quality. Dry weather conditions made it difficult to correctly time corn silage harvests.

Ontario farmers planted 100,000 acres of white beans in 2002. This increase nearly doubled the production figures for 2001. Coloured bean acreage also expanded to over 70,000 acres. In contrast, tobacco production and total value in 2002 were reduced compared to other years. An economic study sponsored by the tobacco industry concluded that the tobacco industry in Ontario would continue to face stiff competition from imported tobacco. The industry recognized the importance of improving tobacco quality and production practices in order to remain competitive in a global economy.

Cool-wet early season conditions followed by mid-summer drought prevailed across much of the province in 2002 often making conditions ideal for pest and weeds. The introduction of pest and herbicide tolerant crops particularly in corn and soybeans continued at a high rate of adoption by growers. Concerns were expressed by various commodity groups that the wide adoption of genetically modified crops might reduce our ability to maintain identity preservation. This may have important implications for established and new export markets.

Farm gate values were available only from 2001 (Fig. 2). Based on last years data cereal crops were grown on 16.6% of the acreage seeded with field crops and produced 13.7% of the total field crops farm gate value. Corn was grown on 27.3% of the acreage and produced 38.6% of the total farm gate value. Soybeans were grown on 25.2% of the acreage and produced 17.2% of the farm gate value. The total farm cash receipts for field crops grown in Canada in 2001 were approximately $36.2 billion for all sectors. Ontario's share of these cash receipts was 23.5% or $8.5 billion. The farm gate value from the field crop sector in Ontario is approximately $2.0

billion. This is in comparison to farm cash receipts of $1.4 billion from dairy, $3.0 billion from other livestock, $0.22 billion from commercial fruit crops, and $0.72 billion from commercial vegetables (including green house crops and mushrooms).

Ontario field crops are a major source of exports although the province is a net importer. In 2001, $1.9 billion in grains and oilseeds products and animal feeds were exported and $2.3 billion imported. Exports account for approximately 88% of the white bean crop and 23% of the soybean crop annually. Although 4.1% of the corn crop is exported, Ontario is a net importer of corn. In order to maintain the viability of agriculture in Ontario the efficiency of production and the quality, safety and marketability of all field crops need to continually improve both to enhance domestic markets and to compete globally. These are the primary goals of agricultural research.

In summary, emerging issues influencing the viability of field crop production in Ontario include:

- preservation of identity preserved GMO and non-GMO crops
- expansion of international export market opportunities -defining an Ontario "brand" identity
- climatic variation
- registration of pest management technologies
- development of bio-based industrial products from Ontario field crops

Fig. 1 Field Crop Trends 1982- 2002

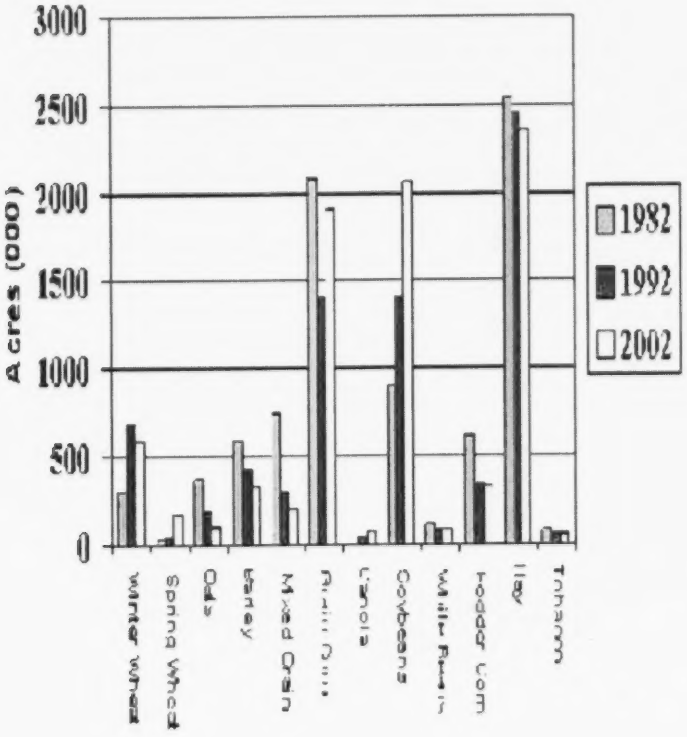


Fig. 2 Major Field Crops
Relative Farm Gate Value - 2001

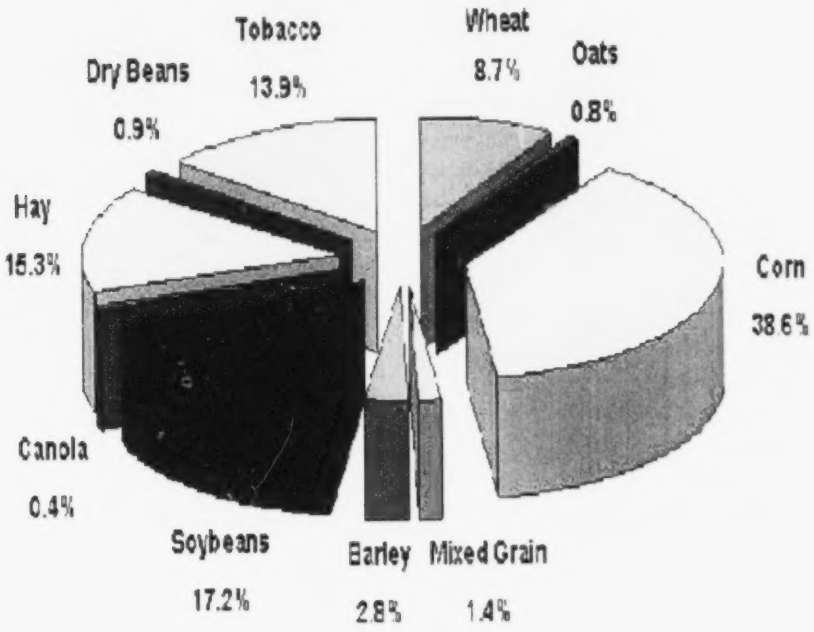


Table 1. Estimated Area, Production and Farm Value of Specified Field Crops, Ontario, 2002,2001 and 2002.

Crop	Year	Units	Area		Production		Farm Value	
			Seeded	Harvested	Yield	Total	Per Unit	Total
			(acres)	(acres)	(units/acre)	('000 units)	($)	($'000)
Winter Wheat[a]	2000	bu	680,000	680,000	74.3	50,500	2.70	136,400
	2001	bu	545,000	540,000	71.9	38,800	3.76	145,800
	2002	bu	580,000	580,000	72.1	41,800	...	...
Spring Wheat	2000	bu	85,000	82,000	46.3	3,800	4.94	18,800
	2001	bu	125,500	125,000	52.8	6,600	4.17	27,500
	2002	bu	170,000	170,000	50.6	8,600	...	...
Fall Rye[a]	2000	bu	80,000	60,000	40.0	2,400	2.67	6,400
	2001	bu	67,000	60,000	35.8	2,150	2.67	5,700
	2002	bu	70,000	60,000	31.3	1,875	...	...
Buckwheat	2000	bu	7,000	5,000	26.0	130	6.21	800
	2001	bu	6,000	4,000	35.0	140	...	...
	2002	bu	7,000	7,000	25.0	175	...	...
Oats	2000	bu	90,000	70,000	61.4	4,300	1.73	7,400
	2001	bu	102,000	90,000	68.9	6,200	2.69	16,700
	2002	bu	115,000	100,000	67.0	6,700	...	...
Barley	2000	bu	250,000	230,000	57.4	13,200	2.49	32,900
	2001	bu	309,000	295,000	66.1	19,500	2.89	56,400
	2002	bu	335,000	320,000	56.9	18,200	...	...
Mixed Grain	2000	bu	200,000	175,000	66.3	11,600	1.84	21,300
	2001	bu	218,000	190,000	68.4	13,000	2.08	27,000
	2002	bu	210,000	190,000	62.1	11,800	...	...
Grain Corn	2000	bu	1,730,000	1,680,000	105.1	176,500	3.22	568,300
	2001	bu	2,000,000	1,960,000	103.1	202,000	3.44	694,900
	2002	bu	1,925,000	1,910,000	113.1	216,000	...	...
Canola	2000	bu	40,000	38,000	36.3	1,380	5.53	7,600
	2001	bu	36,500	35,000	39.4	1,380	6.01	8,300
	2002	bu	60,000	60,000	32.5	1,950	...	...
Soybeans	2000	bu	2,250,000	2,235,000	38.0	85,000	7.07	601,000
	2001	bu	2,250,000	2,225,000	21.1	47,000	7.31	344,000
	2002	bu	2,075,000	2,065,000	33.9	70,000	...	...
Dry White Beans	2000	cwt	55,000	53,000	13.3	705	22.91	16,200
	2001	cwt	58,500	50,000	13.1	655	27.48	18,000
	2002	cwt	85,000	85,000	18.5	1,575	...	...
Coloured Beans	2000	cwt	50,000	46,000	11.5	530	...	...
	2001	cwt	63,000	50,000	10.0	500	...	...
	2002	cwt	75,000	75,000	16.0	1,200	...	...
Fodder Corn	2000	tons	320,000	318,000	12.3	3,900	22.60	88,100
	2001	tons	320,000	310,000	10.6	3,300	23.30	76,900
	2002	tons	325,000	325,000	12.3	4,000	...	...
Hay (b)	2000	tons	2,300,000	2,240,000	2.4	5,400	72.88	393,600
	2001	tons	2,200,000	2,110,000	2.1	4,400	69.52	305,900
	2002	tons	2,500,000	2,350,000	2.2	5,150	...	...
Tobacco Flue Cured	2000	lbs	55,000	55,000	1,900	106,422	2.29	244,204
	2001	lbs	56,500	56,500	2,100	117,094	2.29	267,683
	2002	lbs	...	...	...	...	...	...

[a] Area seeded represents area remaining as of June 1

Source: OMAFRA Statistics

Mandate of Field Crops Research and Services Committee:

The Ontario Field Crops Research and Services Committee and its constituent subcommittees are empowered to review and direct research and services leading to the improvement in crop production efficiencies and competitiveness of Ontario agriculture in world markets. Specifically the mandate of the committee is:

(a) To review reports submitted by Commodity and Pest Management-based subcommittees.

(b) To assess requirements for Field Crop Research and Services

(c) To establish priorities for Field Crop Research and Service programs

(d) To assess progress in Field Crop Research

(e) To develop and present reports and recommendations to the Ontario Agricultural Services Coordinating Committee describing the needs for Field Crop Research and Services including as appropriate information in relation to:

(i) cost-benefit
(ii) research facilities and personnel required
(iii) location best suited for the investigation
(iv) how funds might be obtained or freed to conduct new research or services
(v) operation of crop committees

(f) To consider and approve Chairs and membership of each Crop Committee

(g) To appoint representatives to other OASCC Research and Services Committees when requested and to liaise with the Ontario Pest Management Research and Services Committee.

(h) To provide an inventory of the research effort in field crops

(i) To take a lead role in the documentation of Research Accomplishments and Proposed New Research Directions for ARIO program reviews on a 4-year basis.

Industry/Sector Scan

Cereals

State of the Industry

With near perfect fall weather, high prices and memories of excellent yields over the last 4 years, winter wheat plantings have soared to a new record, well over 1 million acres. About 600,000 acres went into the ground in September, well ahead of normal dates. The crop is in excellent condition going into the winter, with high hopes for record yields next summer.

For the fourth consecutive year, excellent yields were harvested from the 2002 Ontario winter wheat crop. Average yield for the wheat crop was 73.1 bu/ac, despite 2002 planting conditions in the fall of 2001. The total crop is estimated at 1,000,000 tonnes.

Growth of all red wheat classes continues. Current breakout of market classes is 45% soft red, 32% soft white, and 23 % non-pastry red, (40,40, 20 in 2001)

Again in 2002 the wheat crop narrowly escaped severe problems with fusarium. Almost all samples of wheat received by the Canadian Grain Commission had fusarium present, yet only about 9000 tonnes were downgraded to feed due to fusarium.

With the release into Ontario of the variety "Vienna" (SRW), the first of the new generation of "moderately tolerant" (MT) genetics to fusarium is now available to Ontario producers. FT Wonder (SRW), the first fusarium tolerant variety to be commercialized from the team of AAFC (Ottawa) and Hyland Seeds, will be available for release by 2004. A third variety is close to release from Pioneer (SRW)

Spring wheat varieties are also being developed with improved fusarium tolerance. Interestingly, the variety Alsen, developed by North Dakota State University, touted as being fusarium tolerant, and given fast track registration support across Canada (including by the OCCC), is showing up as only an "also ran" against our standard Ontario varieties for fusarium tolerance.

Folicur received emergency registration for the third year, and was applied on 40 to 50,000 acres of wheat. The shortcomings of the fusarium prediction model continued this year, as prediction maps again changed from red to green overnight with missed rainfall events and changing weather forecasts. Growers remain frustrated with these extreme changes due to weather impacts. Full registration of Folicur is a necessity, as a fourth year of emerging registration would be unlikely.

Effectiveness and distribution of seed treatments continues to be a major concern. Dwarf bunt was a minor problem, but did make grain unmarketable on several thousand acres, despite seed treatment with dividend. Individual seed analysis has shown less than adequate seed distribution even with state of the art seed treatment technology.

Demand for Ontario wheat continues at high levels. Quality traits within the crop continue to expand and develop new market classes, often with premiums attached. The loss of the Kellogg's market for the specialty white winter wheat variety Whisper is an unfortunate step backward as we develop these opportunities further.

Utilization of wheat in the feed market continues to be significant. An estimated 200,000 tonnes are utilized in this market, regardless of quality of the harvested crop. Two exciting new feed spring wheats have been supported for registration to help fill this market.

Fusarium in barley was much less of a concern this year with dry, hot weather after heading. However, some feeding problems have been reported and this continues to be a significant potential problem in the crop. Winter barley average continues to grow slowly, with 15,000 plus acres planted in the fall of 2002.

Spring cereal acreage increased for the second year. Barley acreage increased 8% (320,000 acres), oat acreage increased 11% (100,000 acres), while spring wheat acreage doubled to 125,000 acres. Mixed grain acreage remains stable.

Spring cereal yields were variable, with barley crops and late planted crops very disappointing. Oat yields were good at 67 bu/ac, down only slightly from last year's tremendous crop (69), with excellent quality once again. Barley was below normal at only 57 bu/ac, down 14%, while spring wheat was a normal crop, down from last year's 57 bu/ac yield.

The Oat and Barley Council of Ontario has been added to the membership of OCCC. The council is most involved with quality oats and malting barley. The Quaker Oat Company plant at Peterborough, utilized a significant tonnage of Ontario oats again this year. The pilot program (Con-Agra) investigating malt barley production had excellent results. Plans to contract 50,000 tonnes of malt barley from Ontario producers are being executed.

Proposed changes in the variety registration process continue to impact on the industry, and the committee as a whole. The consensus of the committee is to continue with quality and disease as registration requirements, but agronomic factors will not be required. Performance tests are a better venue to test these characteristics.

The Canadian National Millers Association continues to oppose the removal of KVD for white wheat in Eastern Canada. CFIA refuses to move on this issue without support from the CNMA. This will be a major road block for the new types of white wheat being developed by breeding establishments.

The removal of performance testing at Kemptville is a major blow to cereal performance testing. Performance of cereal varieties in the Ottawa Valley region has been shown to be significantly different from performance in the balance of the province. The committee is considering what options it has, with no available funds to replace these test sites.

Leaf diseases continue to cause yield and quality loss in the cereal crops. Stripe rust of wheat was a significant concern in some areas, and is spreading rapidly throughout Southwestern Ontario. Diseases included Stagnospora (septoria glume blotch) which caused significant yield loss in some fields. Heat stress causing interrupted grain fill was another factor impacting yields.

Spring cereal planting intentions are down, due to poor barley yields and the large winter wheat crop already planted. 606, a new spring wheat variety that commanded 76% of the acreage outside of the Ottawa Valley region, had major quality problems with low falling number. This caused havoc with marketing and utilization of the crop. The problem has been traced back to a genetic link between high yield and low falling number from the CIMMYT breeding program. Crop insurance for winter wheat in the Temiskaming district is being re-evaluated. The increased winter hardiness of some of the new winter wheat varieties may make winter wheat a viable crop across northern Ontario.

Significant Research/Service Accomplishments

1. **Ontario Spring Wheat Action Plan**

   Accomplishment: Second Wheat Symposium.

   Why was this work undertaken? There continues to be incredible opportunity for wheat producers, processors, and end users if specific quality traits could be developed and maintained as a pure stream from grower to end user. Several successful examples were profiled to all sectors of the industry in an effort to stimulate further networking and development of partnerships to facilitate more of these win-win scenarios.

   Who did the work and how was it extended? This was an effort of the Ontario Wheat Producers Marketing Board, supported by industry and OMAFRA and AAFC.

   Number of Benefactors: Producers, seed houses and millers and end users can all benefit from this effort.

   Dollar Impact: Premiums of $10.00/tonne are common, relating to increased value to the producer of up to $10,000,000/year. Estimates of the value across industry players run to $40,000,000/year and more.

2. **Registration and Evaluation of Folicur**

   Accomplishment: Folicur was given a second emergency registration in time for application on the Ontario wheat crop.

   Why was this work undertaken? Fusarium continues to be the number one concern in wheat production. The fungicide Folicur, along with genetic tolerance, may allow for significant reduction in fusarium infections and related toxins. This product has been available in Europe and more recently in the U.S., but is not yet fully registered in Canada.

   Who did the work? This was a co-operative effort between Bayer (sponsors of Folicur) and the disease pathologists across Canada. The Ontario component was spearheaded by Dr. Art

Schaafsma of Ridgetown College, University of Guelph, supported by OMARA and industry. An alert website was developed, with ground truthing ongoing.

Number of Benefactors: The entire industry benefits

Dollar Impact: Variable, depending on the year. Has been as high as a $60 million dollar loss. In 2000, fusarium again had a major impact on growers, with estimates of 50 to 60% of the crop grading feed due to fusarium. The 2001 crop was a near miss. On farm evaluation of folicur indicated a 1/3 reduction in fusarium damaged kernels. Work is ongoing.

Emerging Needs and Issues

1. The need for a constant supply of wheat is again plaguing the industry. Low wheat acreage, coupled with high demand, has brought this into sharp focus. Techniques and agronomic practices that ensure wheat acreage on an ongoing basis are essential!

2. The expanding market for wheat in Ontario is an incredible opportunity. The shift to a wide range of non-traditional breads by the consumer has greatly broadened the adaptability and opportunity for non-pastry wheat in the province. Mills operating at 100% capacity indicate the demand that is available for our product.

3. The on-going fusarium saga seems perpetual. It has become obvious that there is a grave need for the development of a reliable measurement tool of fusarium tolerance/resistance from a pathological standpoint. Until we can accurately measure the disease reaction, it will be incredibly difficult to provide the Ontario producer with predictive measurements of varietal reactions to Fusarium.

4. It is evident that some producers are driven primarily by net returns from individual crops, rather than following agronomically sound rotations. The value of these rotations needs to be investigated, particularly for soybeans, to make producers aware of the economic and soil health advantages of maintaining proper rotations. Also, some investigation of the disparity In wheat yields between areas of relatively equal corn and soybean yields needs to be undertaken, in order to increase wheat yields to economic levels in all areas.

5. With genetically modified wheat available in the marketplace, it has been simple for the industry to give assurances that products were indeed "non GMO". However, with a roundup ready spring feed wheat close to release in western Canada, this situation is about to change dramatically. The industry is now faced with determining how best to meet consumer demands, while allowing beneficial technological developments to occur throughout the industry.

Corn

State of the Industry

Production

Grain corn acreage in Ontario held steady at 1.88 million aces, but yields for the third year in a row where below average (Table 1).

Production was most seriously limited in 2001 by low rainfall in the months of July and August. This lack of precipitation was most serious in the areas of the province south and west of London.

Corn acreage predictions for 2003 are lower at 1.8 million acres mainly due to above average winter wheat seeding in the fall of 2002.

Table 1. Grain corn acreage, production and value statistics for Ontario, 1991-2003.

YEAR	AREA (ac) (Million)	YIELD (Bu/ac)	PRODUCTION (Bu)(Million)	$ VALUE (Million)
2003/04[1]	1.80	116	209	$720
2002/03[1]	1.88	108	203	$710
2001/02	1.93	102.2	197	$694
2000/01	1.68	105.1	177	$570
1999/00	1.81	128.3	232	$638
1998/99	1.85	128.8	238	$702
1997/98	1.8	115	207	$800
1996/97	1.75	107.6	188	$838
1995196	1.725	117.1	202	$929
1994/95	1.60	120.6	193	$619
1993/94	1.675	107.5	180.1	$602
1992/93	1.4	97	135.9	$371
1991/92	1.89	111	209	$558

1 Forecast

Grain Corn Supply and Demand

Feed and industrial uses of grain corn in Ontario both continue to increase. However, the most dramatic increases in grain corn use are on the industrial side and estimates continue to call for expansion within this market. (See Table 2).

Future increases in the industrial demand for corn will come from the biofuel (alcohols) and biochemical (organic acids, polyols, and plastic replacements) sectors. The industry will be paying particular attention to the effect that Kyoto agreements may have on biofuel usage.

Ontario is a net importer of corn and will be until acreage or yield levels boost production sufficiently in order to stay in step with rising demand.

Table 2. Grain corn production, imports and usage in Ontario.

	2001/02	2000/01	1995-1999 (average)
	(million bushels)		
Ontario Production	197	177	213
Ontario Imports	57	70	16
Feed Use	162	155	142
Industrial Use	83	82	63

Significant Research/Service Accomplishments

Corn Hybrid Development and Evaluation

Private sector development and evaluation of corn hybrids for Ontario continues to be very active. Seed company support for and participation within the OCC hybrid performance trials was strong in 2002.

Performance testing was enhanced in 2002 with the purchase of new 4-row split plot combine that will harvest all performance trials west of west of Guelph. OCC is delighted with the co-operation obtained from seed companies and the University of Guelph to allow this step forward to be made.

The loss of the corn and cereal position at Kemptville College will force some re-working of hybrid performance testing in eastern Ontario. Traditionally 5 OCC sites were conducted in the east with Kemptville being responsible for 4 and AAFC, Ottawa doing 1.

Hybrids with genetically modified traits made up a significant portion of the market in 2002 (45%). Growth in market share for herbicide tolerant corn hybrids, particularly Roundup Ready increased in 2002 and expectations are for this to increase to 10 % in 2003.

In the 2003 report on Hybrid Performance testing there were 312 hybrids tested and published across all heat unit ranges. These hybrids can be sorted into the following groups:
Bt: 75
Bt (Liberty Tolerant): 16
Imi Tolerant: 12
Liberty Tolerant: 14
Roundup Tolerant: 13
Conventional: 182

The Ontario Corn Committee has some increasing concern over the ability to maintain non GMO compliance as the percentage of RoundupReady increases in the hybrid population and as the apparent allowances for GM protein do not appear to be slackening. (Recently proposed 0.5% in grain by EU)

The Ontario Corn Committee recognizes that unbiased evaluation of RR corn hybrids is not being accomplished in the province due to the seed companies reluctance to enter these hybrids in performance trials that receive conventional weed control. The OCC has set in motion plans to discuss and resolve this issue with the industry with a consideration towards running herbicide-specific performance trials

Emerging Needs and Issues

Corn Production and the Environment

Corn production practices and their impact on water quality will be under greater scrutiny particularly as a result of Nutrient Management legislation. More research and extension will need to address a "systems" approach to manure management and corn production. This systems approach will need to ensure tillage, nitrogen, or other fertility research work does not exist in isolation from manure application technology.

Agronomic Issues and Related Research

Ear rot and Fusarium infection in grain corn continues to be one of the most serious impediments to the improvement of the corn industry. Progress has been made on the development of genetic markers associated with Fusarium resistance and in the development of some conventional inbreds with increased levels of Fusarium resistance.

Cold tolerance research has defined some of the genetic differences that exist pertaining to late season cold tolerance. Techniques have been developed for testing the late season cold tolerance of corn hybrids and inbreds.

Increasing energy costs and the impact on field operations, grain drying and synthetic N fertilizers continue to reduce the profitability of corn production. Research and adoption of lower energy input cropping systems will be increasingly more important and attractive.

Development of the food grade corn industry within Ontario continues to attract interest and research efforts. The food grade corn market continues to expand. Work has moved forward on the identification and development of suitable hybrids, agronomic practices favouring grain quality, and drying and handling systems to meet food grade expectations.

Variant types of Western Corn Rootworm have been identified in the US Cornbelt that lay eggs in soybeans and thus force growers into using soil applied insecticides to control rootworm feeding even in a corn-soybean rotation. Work at the University of Guelph is developing DNA based techniques for identifying the variant rootworms.

Oilseeds

State of the Industry – Soybeans

Soybean acreage has decreased, from 2.2 million acres last year to approximately 2.0 million acres in 2002. Extremely low yields in 2001, as well as low prices, were the major reasons for the decrease in 2002. The 2003 crop is expected to decline by an additional 10-15% (with 1.7-1.8 million acres of soybeans projected). This continued decline in soybean acreage is partly due to the second year of discouraging yields and higher winter wheat margins.

For the second year in a row, yields were significantly lower than the long-term average. The Ontario average yield is expected to be 33 bu/ac, down from a long-term average of 38.9. Yields were extremely variable across the province, with some fields yielding only 8 bu/ac while other regions achieved yields in excess of 60 bu/ac. Why were yields so low?

-Extremely dry weather in July, August and September
-Exceptionally hot weather
-A wet spring, which delayed planting

Prices have been significantly improved over the last number of years reaching in excess of $9.00 per bushel at the crushers this year.

Green soybean seed at harvest caused considerable dockage for some producers. Those areas that were the driest during the latter part of seed maturation had the highest levels of green beans. This problem caused the crushers to impose grade discounts depending on the percentage of green beans present in the sample:

- (300,000-400,000 acres) 15-20 % of crop had some green beans
- (120-160,000 acres) 6-8% of crop was sample grade
- (60,000 acres) 3% of crop hit with severe sample grades ($80/tonne discount).

Identity Preserved (IP) soybeans are a key component of Ontario's soybean industry. In 2001 approximately 30% of Ontario's soybean were part of an IP system. Demand for specialty food grade soybeans and non-GM soybeans continues to grow. Ontario has had a strong reputation for top quality soybeans. This, along with Ontario's ability to segregate these beans efficiently, has produced a strong provincial IP industry. However, lower quality and low yields have caused considerable difficulties over the last two years. Quality in 2001 was very poor due to drought and insect damage. Many exporters could not meet their export obligations. This year 'green soybeans' have caused the downgrading of a large percentage of IP soybeans. Some exporters are again having a difficult time meeting their export obligations.

Premiums for IP soybeans enticed many growers to that market. However, over the last two years quality problems resulted in many farmers not meeting premium requirements. This, along with the lower yields associated with IP soybean varieties, has resulted in widespread disappointment for IP soybean growers. Combine capacity is reduced with limited harvest hours and the threat of contamination (i.e. changing from corn to beans or non GM beans to GM beans as weather allows). IP soybean acres declined to approximately 20-25% this year.

The adoption of Roundup Ready (RR) soybeans across the province has been phenomenal. In 2001 approximately 30-35% of the crop was RR. This year that number increased to 45-50%. This percentage is expected to increase by another 10-15% for 2003. Weed control problems with conventional varieties, improved RR varieties, quality, yield, and premium issues with the IP sector have driven this increase. The convenient fit of RR soybeans into a reduced tillage system is another reason for this rapid expansion in RR acres.

The soybean variety registration process continues to be under review. Last year the proposal was that soybeans would fall under Schedule B – registration without merit requirements but requiring one year of performance data. However in the new proposed variety registration system, soybeans will fall under Schedule 'C'. This will mean the loss of merit requirements as well as performance data requirements for registration. With these reduced standards, even more emphasis will need to be placed on generating data which allows producers to make profitable variety decisions.

A strong performance testing system is key to the continued success of the soybean industry in Ontario. With the development of new traits through biotechnology, this performance data is critical in evaluating the potential of new varieties.

Three Roundup Ready White Hilum (RRWH) varieties were supported for registration by OOPSCC. Previous to 2002 no RRWH varieties had been submitted for registration. Before the introduction of RRWH food grade soybeans to Ontario, white hilum soybeans could be easily identified by their white hilum as being non-GMO. This gave assurance to buyers who did not want genetically modified soybeans that white hilum soybeans from Ontario were GMO free. The result was the formation of a category of export beans known as Special Quality White Hilum (SQWH) soybeans. Although the exact variety or origin of these SQWH soybeans was not recorded, the buyer could be assured that they were not genetically modified. However, this class of soybeans has been decreasing in popularity in favour of a full identity preservation system over the last number of years. As RRWH varieties become more prevalent in Ontario, it is anticipated that SQWH market share will continue to decline.

- Soybean pests continue to cause considerable damage and concern. Twenty samples from twenty different sites, from commercial fields located in Essex County, Grey County, and Ottawa region, tested positive for Bean Pod Mottle Virus (BPMV) this year. Thirteen samples from thirteen different sites, from commercial fields spread from Essex County to Ottawa, tested positive for Soybean Mosaic Virus (SMV).

State of the Industry – Canola

Ontario farmers planted an estimated 50 000 acres of spring canola with an average yield of 1600 lbs. An increasing number of growers are switching to a direct harvest system. Strong prices are creating interest among growers and acreage is expected to increase in 2003

In the past several years canola oil has traded at a premium to soybean and other forms of oil. The industry is concerned that buyers may switch to these less expensive oils in the long term.

Short season soybeans continue to move into the southern canola-growing region.

Ontario Canola Growers imported and planted an estimated 5000 acres of European hybrid (Kronos). In Ontario performance trials this hybrid yielded 20-30% higher than the check varieties. This variety will be eligible for registration in 2003.

Cabbage Seedpod Weevil and Swede Midge are two new insect pests of spring and winter canola in Ontario. A survey of the Cabbage Seedpod Weevil showed that populations were present in most growing areas. Integrated Pest Management (IPM) research is needed for both pests.

75% of Ontario's canola crop is Roundup Ready (RR) leading to potential weed resistance problems as well as the problem of controlling volunteer canola in following crops. There is also concern with cross-pollination between non-GMO and GM crops.

There is a need for more research into production parameters. Seeding rates, row width, N requirements may be needed to reach optimal yields need to be researched. The Ontario Canola Growers Association received funding from CanAdapt to evaluate Nitrogen Management in canola.

Producing non-GM seed is an issue -- again the threat of cross-pollination. As a result this seed is grown in isolated areas.
With the introduction of seed treatments such as Helix and the elimination of Counter calibrating exact seeding rates has become more difficult. The expense of hybrid seed and new seed treatments has made this issue even more important. Some producers are considering 14" rows for more seeding accuracy.

Emerging Needs and Issues

1) Breeding for Yield and Production Stability. Continued strong support of public soybean breeding programs is essential to ensure new varieties suited for Ontario's unique climate are bred.

Both 2001 and 2002 saw reductions in soybean productivity in Ontario due to extreme weather. These reductions have cost Ontario significant financial losses. Plant breeding will help reduce such declines in productivity and re-establish an upward trend in soybean productivity.

2) Performance Testing of Soybeans and Canola. Reliable third party performance data is vital information to Ontario farmers. Strong support of performance testing by all levels is recommended.

3) Plant Genomics. Current support of agricultural plant genomics is low in Ontario and needs improvement.

The science of Genomics is the study of the activity of many genes in time and space. The information generated from genomics will be available to scientist studying individual genes or

processes. Genomics funding needs to be broad based and come from both the provincial and federal levels.

4) Environmental Impact. Recommend the formation of a team to address the impact of soybean production on the environment.

Agricultural activity impacts the environment. To address the concern of many in the non-agricultural sector, the impact of agricultural impacts on the environment needs to be well defined. Agricultural producers endeavor to be good stewards of the environment and undertake production methods to mitigate their impacts on the environment. A team of multi-disciplinary team of scientists will be able to outline current efforts toward environmental stewardship and to identify new research to address the impact of soybean production on the environment. This team could include cropping systems researchers, weed scientists, agronomists, agmetiorologists, soil and water scientists.

5) Increased attention to alternate uses for soybean. Invite interaction with UG and AAFC-Guelph Food Scientist.

Increased uses for soybeans will provide opportunities to increase markets and to add value to soybeans. The OOPSCC committee members would invite further interaction from food scientists from the University and Federal Labs at Guelph.

Forages

State of the Industry

Alfalfa winter survival was generally excellent, even though there was extensive harvesting during the Critical Fall Harvest Period the previous year. Most of the winterkill was limited to poorly drained fields. Forage inventory carry over in the spring was generally considered adequate.

Warm weather in early April resulted in alfalfa breaking dormancy, but cool, wet weather beginning mid-April delayed forage growth considerably. The cool weather slowed the growth and development of the legumes more than the grasses. Many mixed stands contained a high proportion of grasses.

Alfalfa weevil was at threshold levels in many parts of the southwest and some spraying was done. Some second cut regrowth was also affected. Potato leafhopper levels were very high in the southwest, north of Lake Erie, compounding the effects of the dry weather. New alfalfa seedings were particularly affected.

First cut harvest was delayed, initially due to cool weather and delayed growth, and later by frequent rains. First cut yields were generally very good to excellent. Hay quality was frequently reduced due to a high proportion of grasses and June rains resulting in either delayed harvest or

mold damage. Laboratory analysis after first cut indicates that fibre (NDF) levels were higher than normal, but fibre digestibilities (dNDF) were often higher than expected.

Dry weather in late June and July resulted in lower second and third cut regrowth and yields and pasture production. In general, western Ontario was more severely affected by dry weather than eastern Ontario. Fields where first cut was completed late had very little second cut regrowth. Third cut regrowth was frequently nonexistent due to a lack of moisture. Alfalfa fields responded to the moisture stress by decreased number of stems, reduced stem elongation and yield, but increased leaf to stem ratio. Second and third cut laboratory analysis was frequently higher in crude protein and lower in NDF than normal.

Continuously grazed pastures were typically overgrazed and out of feed in July. Cattle on these pastures required supplementation with hay. Rotationally grazed pastures were more productive.

New forage spring seedings were successful if done early, but later seeded fields were much less successful due to dry weather. Dry weather in July and August delayed and reduced summer seedings in many areas of the province.

Forage inventories varied widely across the province, depending on rainfall. Inventories are greater in the east compared to some of the severely dry areas in the western parts of the province. Farmers evaluated forage inventories and developed various strategies to ensure adequate feed supplies. This resulted in some increased hay and standing hay prices later in the year. Some beef calves were weaned earlier than normal and sold. Similar to last year, some alfalfa fields were cut well into the Critical Fall Harvest Period. Where low forage inventories existed, extra corn silage was made to compensate. In the severely dry areas, there was corn with poor grain development salvaged and harvested as corn silage. Corn silage quality was extremely variable, with some excellent quality and some being much lower in digestible energy. Dry weather conditions made it more difficult to correctly time corn silage harvest. The risk of nitrates in forages was of some concern at harvest, particularly with green chop.

Significant Research/Service Accomplishments

Seeding of 17 new entries proceeded well at the various test sites. Entries were planted at Elora, Pakenham, New Liskeard, Huron Park and Thunder Bay in that order of frequency.

Trial inspections were held in the south and in the north with harvest data recorded at each station.

The production committee met in Guelph on August 22, 2002 with discussion largely centred on research, publications and the need for variety testing in the province.

The variety committee met on November 19 and 20, 2002. Support was given to 3 alfalfa varieties and another 22 alfalfa varieties subject to satisfactory bacterial wilt resistance. One early orchard grass variety was supported.

Variety Concerns

The OFCC has steadfastly supported the position of farmers in the province to maintain performance testing in the province and also supports performance testing for the registration of forages. In terms of variety registration the variety office of CFIA has yet to make a definitive statement on it's position as to whether forages should be in schedule "B" that is performance testing required or in schedule "C", performance testing not required for registration. At the moment they are in "B". The OFCC has urged both the Expert Committee on forages and CFIA to support evidence of performance requirements. (Appendix I)

The OFCC has requested that reed canary grass be placed in schedule "A" because of concerns regarding alkaloids in Ontario. CFIA variety office has turned down this request in the interests of a uniform national policy.

The forage seed trade has taken the position that forages should be in schedule "C". They have told the OFCC that their greatest concern is the cutbacks in the system and they foresee a situation where testing committees will be unable to carry out their mandate to test forages. Conversely they indicate that a system that would insure smooth and expeditious passage of new varieties would alleviate these concerns.

OFCC Successes

The OFCC instituted a new fee schedule, which has been very well accepted by the seed industry. For seed companies simply wishing to have their results in the brochure a membership has its benefits has been undertaken. The membership fee is $1,500.00 per year and the benefit is inclusion in 40,000 copies of the brochure and in media print of the brochure as well as being posted on the Internet. Seventeen companies have paid the membership and so the brochure is being printed and circulated. Companies not wishing to be in the brochure may have their varieties tested without the need to be a member. Details of services, fees and memberships are given in appendix II.

Pest Management – Weeds

State of the Industry

Early conditions were favorable to the activity of preemergence herbicides. The summer draught made use of post-emergence products more challenging. An increase in the adoption in Roundup-Ready technology has been seen in many areas. This is probably due to expectations of high performance, relative simplicity and resistance to other herbicides developing. Drift problems were encountered and there were also instances of glyphosate being applied at the wrong time resulting in weedy fields.

Weed Control Results

Because of the conditions this spring, weeds tended to be ahead of crops. This made timing of herbicide application tricky. They also started to grow very fast when the heat finally arrived. There was a compressed window for POST emergence applications. The reasons are manifold:

- Many different crops emerged at the same time;
- Some burnoff treatments were missed because the crop had to get in;
- In some areas (especially east), rain has prevented early post applications.

Crops were stressed through emergence and during the early POST treatment window. In some cases, PRE treatments did not get in because farmers did not want to further stress the crops. All in all, timing very often difficult to find for both PREs and POSTs. Crops were often slow to become competitive which does not help. Hot and drier conditions in late June and July made for drought-stressed weeds that did not respond well to post emergence herbicides.

Timing of post emergence treatment is still an issue, especially with products that have no soil activity. Waiting too long in order to control all the weeds maybe costly as losses to competition have already occurred. For example, it was estimated that if treatments were not applied to corn by the third leaf-stage, yield losses equivalent to $5/day would occur. In soybeans, the cut-out timing appears to be the 1-2 trifoliate stage.

Trends

- Continued move to Roundup Ready, mostly due to complexity of other programs based on conventional herbicides.
- Roundup-Ready is not necessarily a "less-management" program.
- Margins in the agro-chemical are very slim. Not many new herbicides in the pipeline.
- Research indicating that low drift AI nozzles may negatively affect performance of contact herbicides.
- Changes to Minor Use Program that were announced last summer will affect some research programs. More details are being awaited.

Minor Use Program for Herbicides
Extension Activities

- The Weed Management Specialist (Field crops), whose position was vacant following Hugh Martin's reassignment was filled by Mike Cowbrough in April 2002.
- Guide to Weed Control (Pub 75) is now a biennial publication. The 2003 version, a supplement to the 2002 Guide, will be available in January. The 2004 version will be the first one in its biennial incarnation. Plans are being made to ensure availability and distribution of the supplement and special emphasis will be put on a web based version.
- Ontario Weeds (Pub 505) is still in revision.
- Plans have been made at the November meeting to ensure that fact sheets will be revised. Leslie Huffman has garnered volunteers who have agreed to write the revised fact sheets. They should become available in the year 2003.

Issues around Roundup-Ready

More Roundup-Ready soybeans are being grown. There are issues with timing and expectations. Some believe that one just needs to go with 1 liter of Roundup and all the problems (annuals and perennials) are solved. There is a need for increased explanations on what the limits of this system are. Many farmers are waiting too much to spray. There is a need to stress that under

moderate to heavy weed pressure, waiting until the 2nd trifoliate (or even later) will result in yield loss. Waiting too long may mean you may not be able to access field in time if there is heavy rain. Roundup will clean soybeans even when big and thick weed stands are treated at the flowering stage but this aesthetically pleasing outcome is reached at the cost of diminished revenues.

Many very weedy fields of Roundup-Ready corn were observed. Once again it seems that this is a question of expectations. Growers may have sprayed once and walked away, expecting that the job was done. The non-residual nature of glyphosate needs to be recognized, especially considering that many of the traditional corn herbicides (atrazine, Banvel, Dual, Frontier) have soil residual activity.

Problems with glyphosate drift have been seen more often this year. This is due to the increase Roundup-Ready crop acreage, but also to the fact that many growers are putting in a few acres of vegetable crops in areas that were typically used for field crops. There are also more greenhouses where glyphosate damage would have significant impact.

Problem Weeds

It appears that some "old friends" are still around and are sometimes increasing in numbers. Newcomers also joined them, which makes management trickier. Nipplewort and biennial wormwood are some of the newer problem weeds that were encountered in 2002. Common waterhemp (*Amaranthus rudis*), a major weed problem in the US Mid West, was thought to be absent from Ontario until last summer. It was documented in two fields in Essex and Lambton counties. In both cases it survived applications of Pursuit and was too tall to be well controlled by contact herbicides used as rescue.

Herbicide Resistance

New cases in 2001 that were confirmed in February 2002 include lambsquarters resistant to Pinnacle, green foxtail resistant to Pursuit and cocklebur resistant to Pursuit, Classic and FirstRate.

There were few reports in the summer of 2002 of problems with ragweed resistant to ALS inhibitors. It is believed that growers assume that most ragweed plants are resistant so they are switching to alternative modes of action, glyphosate being one of the most popular. The fact that two companies decided not to support their ALS herbicides for ragweed in five counties in the Southwest was related to resistance.

There were a few cases of resistant pigweeds and nightshade sent for testing and resistance confirmation at the University of Guelph in the fall of 2002.

Pulse Crops

State of the Industry

I. Ontario farmers planted about 100,000 acres of white beans last spring. Acreage nearly doubled 2001 acreage. Other North American growing regions also ramped up acres. Ontario harvested a crop of 1.5 million bags. Overall North American production

rebounded well above historical utilisation numbers and stocks are projected to be burdensome once again. Prices have of course hit the skids with the Ontario posted grower price dropping from $26-$29/cwt initial price to under $20/cwt.

II. Coloured bean acreage expanded to over 70,000 acres.

III. Two out of three of the largest buyers in the world for white beans have moved to an Internet Dutch style price discovery system for purchasing beans. The industry is concerned this will exert further downward pressure on prices, and make it much more difficult for smaller dealers to market beans.

IV. The White Bean Producers and Coloured bean Growers injected some interim support money to maintain the bean breeding and bean pathology program at the University of Guelph.

V. The Ontario Dry bean industry is collaborating with Pulse Canada to develop a national strategy for Canada's Pulse Industry. The strategy is receiving favourable review from AAFC. An emerging priority for research is the development of speciality edible bean types and alternative markets or market uses. Ontario has a mature industry that is well positioned for a higher value added edible bean market.

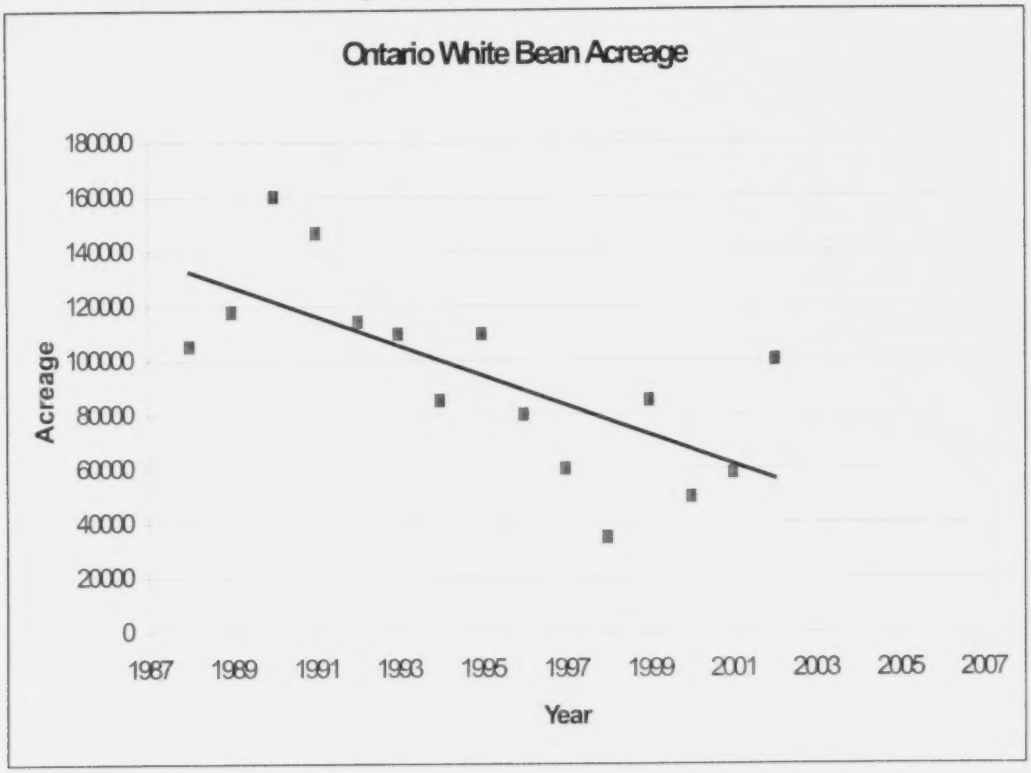
VI. IPM research utilising experimental seed treatments for early season control of leafhopper is yielding promising results.

VII. A replacement to lindane for seedling insect control is required. The loss of streptomycin could become an issue in trade of seed with the USA.

White Bean State of the industry

Dry edible beans represent between 1 ½ to 2 percent of the total acres under cultivation in the province Although acreage of white beans nearly doubled 2001 acreage; the overall trend in Ontario WPB acres continues to decline (Table 1). An increasing percentage of white beans are marketed outside the pool. In 2001, fewer than 30 percent of white beans were marketed through the pool. Two of the largest offshore buyers are now using the Internet to source their bean requirements. Approved and invited suppliers are asked to participate in "reverse" auctions whereby they submit offers below the buyers reserve bid level for rigorously specified quantities. Whether this buying paradigm can 'buy' acres in such traditional growing regions as Ontario remains to be seen. As other commodity prices show better returns, producers may choose to grow these more 'price liquid' crops. Global consumption of WPB has been static near 7 million cwt. for the past 25 years. There have been no noticeable changes in consumption patterns. North American acreage has remained around 500,000 acres and N.A. production accounts for the majority of world production. Manitoba has become a significant producer, with an economic advantage over Ontario due to lower land costs. Average yields in Manitoba are now similar to Ontario's (Table 2). In 2001, Canada outproduced the USA in white bean production for the first time.

Table 1. White Pea Bean Acreage Trends Acres*



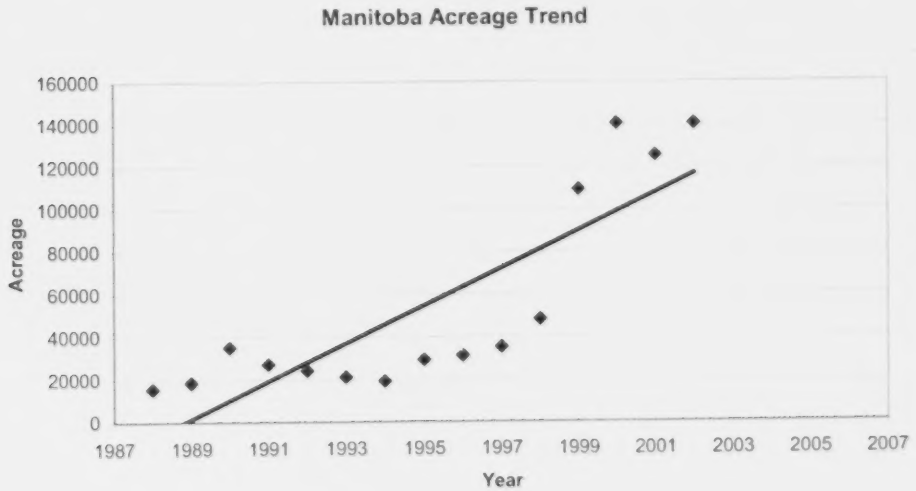
Year	Ont.	Mich.	Min/Dak.	Man.	Total
1988	105000	205000	206000	15500	531500
1990	160000	235000	257000	35000	687000
1992	114000	235000	160000	24000	533000
1994	85000	250000	160000	19000	514000
1996	80000	200000	190000	31000	501000
1998	35000	90000	180000	48000	353000
1999	80000	150000	235000	109000	574000
2000	50000	135000	225000	140000	550000
2001	58000	48000	125000	115000	346000
2002	100,000	85,000	240,000	140000	565,000

* Figures supplied by Ontario Bean Producers Marketing Board

(Table 2) Average White Pea Bean Yields*

	Manitoba	*Ontario*
1988	5.80	12.20
1989	5.81	13.15
1990	11.00	13.47
1991	11.57	16.73
1992	8.60	8.07
1993	4.61	14.14
1994	15.32	15.83
1995	14.04	17.38
1996	14.68	11.06
1997	14.00	14.77
1998	16.90	14.42
1999	16.57	16.41
2000	13	11.99
2001	14.7	10.27

- Figures supplied by Ontario Bean Producers Marketing Board



Coloured Bean State of the industry

Ontario coloured bean acres continues to expand (Table 2). Part of the expansion is due in part to the interest in production contracts. Expansion in acreage in all major producing areas in N.A. in 2002 has resulted in lower harvest prices. U.S. per capita consumption of Pinto, black beans

and to a smaller extent cranberry has increased over the past 10 years. Attributed in part to the growing Hispanic population. One significant trend is the average price for beans on the world market is dropping. This indicates greater economies of production are required as new production regions emerge. In Ontario, the 2002 size and quality of the crop was excellent although there was some concern with check seed coats due to low harvest moisture. Research projects that OCBGA fund include breeding programs for Dr. Tom Michaels, Dr. Soon Park, Dr. Kangfu Yu, Biological Control of White Mold, Root Rot Trials, leafhopper seed treatment trials, timing of Desiccant Trials, Performance and Variety Trials and Weed Control. Joint consumer promotions with the Ontario White Bean Producers Marketing Board are undertaken throughout the year. For further information, contact Bernadine Wolfe, Secretary, OCBGA.

Table 2. Coloured Bean Acreage (Major classes)*

Year	Acres Insured	Average Yield
1991	15,182	18.4
1992	13,547	7.9
1993	19,108	15.9
1994	20,837	16.9
1995	25,781	17.1
1996	22,315	12.5
1997	23,527	17.1
1998	24,885	17.3
1999	43,666	16.2
2000	44,244	10.2
2001	53,377	-

- Figures supplied by Agricorp

Significant Research/Service Accomplishments

Evaluation of Seed Treatments for Leafhopper Control

Accomplishments

- 3 experimental insecticidal seed treatments (i.e. Thiamethoxam, Imidacloprid, and Clothianidin) provided good early season control of leafhoppers. Excellent control of wireworm and good control of seedcorn maggot is also reported.

Why was this work undertaken?

- A replacement seed treatment insecticide is required to replace lindane.
- High populations of leafhoppers during the past several dry growing seasons have resulted in growers using repeated applications of dimethoate.

Who did the work and how was it extended Chris Gillard, RCAT- University of Guelph. Funding received from OMAF, Pesticide Co.

Number of Benefactors Growers benefit from lower input costs and reduced exposure risk to pesticide. Elimination of one application of dimethoate reduces the exposure to bees foraging in the area.

Dollar Impact. The cost of the seed treatments are less than ½ the cost of one pass of field spraying. The cost of one application of dimethoate over 130,000 acres would be approximately $1.7 million.

Emerging Needs and Issues

Issues with Research Priorities

1. Genetic Improvement, and Cultivar Development of White and Coloured Beans
2. Edible Bean quality evaluation and utilization.
3. Integrated Pest Management for Insects and disease.
4. Integrated Weed Management
5. Development of alternative pulses, specialty market types and markets

Emerging Issues without specific research priorities

6. Technology transfer
7. Performance testing
8. Biotechnology.

Ownership of genes, transformation processes, and technology impedes the advancement of the industry through public/ private breeding efforts. Health concerns with PNT is interfering with the registration of varieties developed using traditional breeding techniques (E.g. OAC Rex). CFIA & Health Canada are concerned that OAC Rex is a novel type, and have requested that OAC not only prove that the variety is not different from other registered varieties, but also to pay for and produce the data for base line numbers for other registered varieties.

9. Flatulence. As the population ages, individuals develop more intolerance to high fibre diets. High fibre consisting of complex carbohydrates and partially hydrated starch contributes to flatulence.

10. Weed Control. Weed control herbicides available in edible beans relies on testing of herbicides registered for soybeans. The focus of herbicide research in soybeans has shifted from development of new active ingredients to introduction of novel trait herbicide resistance. In the next 5 years no new chemistry is expected to become available. This is of concern because of the reliance on group 2 chemistry, and the rapid increase of certain resistant weed biotypes. In addition limited chemistry exists for the control of certain problem weeds.

11. Internet auction of white beans.

Tobacco

State of the Industry

STATE OF THE INDUSTRY

Crop area, market production and total value in 2002 are the lowest compared to other years. In response to concerns of the tobacco industry, 100% of tobacco growers have replaced the conventional heating system "direct firing" to a new system called "indirect firing" when curing tobacco leaves.

A new study was conducted on the "Economic Contribution of the Tobacco Industry in the Tobacco-Growing Regions of Ontario in 2001. The purpose of this study was to examine the economic impact of the Ontario tobacco industry in the tobacco growing areas of Ontario. The study was also designed to examine the economic impact of a potential reduction in the

production of Ontario domestic and export flue-cured tobacco. The result of the study concluded that that the Ontario tobacco industry risks a future in which there is no longer a "seed-to-processor" industry in the study area, and that ultimately the entire economic activity of the Ontario tobacco industry may be eliminated through the use of imported tobacco.

The tobacco industry recognizes the need to improve tobacco quality in order to compete in a global market and continues to take a proactive role in grower education. During the winter of 2002/03, the most recent research information on tobacco production will be presented to growers in a series of workshops and winter meetings.

Table 1: Area, yield, market production and total value of tobacco grown in Ontario

YEAR	AREA	Market Production		Total value
	Acres	'000 lb	'000 kg	$'000
2002*	41,342	108.100	49,077	243,700
2001	52,977	117.100	53,163	264,000
2000	55,000	106,422	48,273	244,278
1999	59,500	142,379	64,583	308,933
1998	65,500	150,576	68,300	326,525
1997	66,000	154,913	70,267	341,928
1996	66,930	142,241	64,519	317,896
1995	62,500	152,187	69,031	316,802
1994	57,260	129,621	58,795	271,476
1993	69,250	156,412	70,947	311,362
1992	63,500	131,101	59,466	265,870
1991	65,180	154,100	69,899	294,546
1990	64,000	123,230	55,896	243,009

*Forecast

Significant Research/Service Accomplishments

1. Senator is identified as effective as Benlate for controlling Rhizoctonia Damping-Off of tobacco

Rhizoctonia damping-off is controlled through the application of Benlate 50WP to the beds during seedling development. The manufacturer of this fungicide, DuPont de Nemours, suspended production of this product in early 2001. As a result, several different fungicides were evaluated for their ability to control *Rhizoctonia* damping-off of developing tobacco seedlings and their performance was contrasted with that achieved through the use of Benlate at the currently registered rate (i.e. 125 g product/100 m^2 of bed surface). It was found that Senator

70WP, prevented plant mortality at a level similar to that seen with Benlate when used at rates of either 90 or 125 g product per 100 m^2 of production area.

2. Rapid bioassay for black root rot screening

In addition to field screening, black root rot resistant cultivars are developed in a tank test with controlled room and water temperature. F2 populations involving crosses between lines immune to black root rot and susceptible improved cultivars are planted in tubes filled with perlite and silica sand and placed on trays containing soluble NPK nutrients. Plants are inoculated with the spores of *Theilaviopsis basicola* three to four weeks after transplanting, and individual plant scoring takes place three weeks after inoculation. At least 9-10 weeks is required to complete the cycle of screening. A new bioassay for black root rot screening was developed where germinating seeds in petri dishes are inoculated with the fungus. Within two weeks after inoculation the seedlings are screened for resistance/susceptibility to black root rot.

3. Field evaluation of NC297 for control of tobacco mosaic virus

NC297, an American tobacco variety was successfully screened for immunity to TMV at a grower's farm known to have a history of TMV infestation. Currently, there is no registered tobacco variety in Canada resistant to TMV.

4. Hybrid development

Tobacco hybrid production is gaining popularity in the United States and many parts of the world. The first commercial hybrid in the United States was released in 1994. Despite that heterosis and hybrid vigour for yield and quality traits are not fully expressed in the F1, the advantages of growing hybrids lies mainly in the shorter time frames required to produce hybrids, the dominant expression of disease resistant genes in hybrid combinations and the full control of seed production. Canadian F1 hybrids were developed in 2000 using a male sterile line and tested for 2001 and 2002. The results obtained from the hybrid trial are very encouraging.

5. Development of haploid system to enhance the breeding program

Haploid plants were successfully developed through interspecific hybridization between the cultivated *Nicotiana tabacum* (F1 hybrids) and *Nicotiana africana*. Diploid plants were regenerated by culturing the leaf disc (midvein) into selected media for shoot and root regeration. As compared to conventional breeding, pure lines of superior yield and quality can be produced through the double haploid program within a short period of time.

6. Development of male sterile line to help develop hybrids

Several male sterile isogenic lines were developed following intraspecific hybridization between *Nicotiana tabacum* lines. The original source of the cytoplasmic male sterility is from *Nicotiana suaveolens*. This source of male sterility (cms) has been used on a global basis for hybrid seed production with little if any agronomic penalties in a cultivar's performance.

Emerging Needs and Issues

Tobacco Mosaic Virus (TMV), Tomato Spotted Wilt Virus (TSWV), and Brown Spot are becoming major concerns to tobacco growers. The introduction of mechanization, particularly, the increasing trend of machine harvesting tobacco may help spread these diseases. More attention needs to be paid to disease problems experienced in the southern tobacco states and that these should be treated as potential future problems for the Ontario tobacco crop. Severity of brown spot varied in the variety CT572. One field of CT572 was abandoned in the 2002-growing season due to severe leaf spotting. There is a need to develop varieties resistant to these diseases through the conventional breeding program.

Drought conditions: In the past 2 years tobacco growers experienced severe shortage of rainfall coupled with above average temperature. Current tobacco cultivars are susceptible to drought. There is a need to address this issue through the use of broad base germplasm with some degree of resistance to drought stress conditions.

Disinfection of tobacco plant production trays: Tobacco growers are concerned about the repeated use of plant production cell trays. It presents a risk to the tobacco industry for the transmission of diseases. In recent years, one farming operation was devastated by the transmission of tobacco mosaic virus (TMV) as a result of contamination originating from re-used cell trays. Therefore, there is a need to investigate the effects of a number of disinfection procedures using heat and/or chemical agents on the microflora associated with used transplant trays.

Strategic Directions: Research

Recommendation 1

Agronomic Systems and Environmental Stewardship

Research leading to production systems and their components which enhance competitiveness, food quality and safety and environmental sustainability.

Successful field crop production requires the integration of many complex components. The target of high yields and high quality with low environmental impact while maintaining profitability is extremely difficult in biological – based systems, which operate in global markets subject to political influences. The ability to integrate decisions on cultivar/hybrid with those on planting date, tillage system, row width, seeding rate, weed management, pest management, heat unit area, soil type and a host of others plus all of the interactions between these components requires solid reliable research information. Research not only on individual components of production systems but research on the integration of those components (systems approach). Thrown into the equation are the inevitable shifts in pressures from new pests (aphids, European chafer, western corn rootworm variant), expansion of old pests (SCN, fusarium) new weed species (problem weeds, herbicide-tolerant weeds), soil management concerns and new issues of carbon sequestration and reduction of greenhouse gases. Imposed on this background is the fundamental requirement to maintain a competitive industry.

The research priorities described below attempt to address these issues through both strategic, integrated approaches and individual targeted goals.

Specific Commodity / Discipline Based Priorities

1. Strategic Approach to Controlling Field Crop Pests – Field Crop Pest Management Committee:

The following list of field crop pests are placed in order of priority in terms of research needs. Strategies differ for each pest and include management, chemical controls, breeding, economic thresholds and pest biology. In most cases no single approach is warranted, but rather an integrated long-term strategy involving several approaches is advised. This should involve collaborative work with pathologists, entomologists, breeders and agronomists.

Soybean Aphid: Economic impact (thresholds), Management, Chemical controls, efficacy and non-targets, Plant breeding, Biology, life cycle, overwintering, sooty mould relationship, Relationship with other insects, Vectoring viruses

European Chafer: Decision Thresholds, Scouting monitoring predicting, Biology, Control measures, Chemical, Cultural, Biological

Fusarium: include economic impact statement when sending this to FCRSC and OPMRSC. Resistance breeding, New chemistry, Grading system wheat- inconsistent

Soybean Cyst Nematode: Population dynamics -Race shifts, Spread of SCN, Management

Corn Rootworm: Risk assessment for soybean variant in Ontario

White Mould: Resistance, Management - New products to replace lost Chemicals

Root Rots (Pythium, Phytophthora, Rhizoctonia, Fusarium), Thresholds, Better management tools Biology

Corn Stalk Rots (Anthracnose, Fusarium, Gibberella) Implications of cropping systems to disease, Management

2. Greater Energy and Environmental Efficiencies – Ontario Corn Committee

Increasing energy use efficiency is critical to the health of the corn industry in Ontario. Specifically, research must continue to result in improved nitrogen use and grain drying efficiencies.

Nitrogen fertilizer represents a major input cost in corn production, is a significant component in many animal manures, and has the potential to adversely affect the quality of surface water and groundwater. Cropping system research must take an integrated approach to combine tillage, crop rotations, cover crops, manure management, soil testing, site specific technology, etc. to enhance productivity while protecting the environment.

Grain drying costs represent a competitive disadvantage to the corn industry in Ontario compared to many other jurisdictions. Research must continue to develop grain-drying systems that represent reasonable capital investments while significantly improving energy use efficiencies.

3. Develop management strategies for emerging problem weeds that will be sustainable in the long term. Ontario Weed Committee

The Issue:

Profound and dramatic changes have occurred in cropping systems across Ontario over the past decades. The increasing adoption of conservation tillage practices and the introduction of new herbicide technologies have caused the emergence of new weed problems. In most cases, the "new" species take over niches left open or created following changes in tillage and/or weed management practices. Problem weeds are very often perennials although spring and winter annuals are also encountered. These species are challenging for growers, as they are often not covered by herbicide labels.

Current Research/Extension Activities:

Current research adequately assesses which herbicides are effective on specific weed species. Research on many problem weed species has been conducted or is currently being done at the Ridgetown Campus and the Main Campus of the University of Guelph, and at AAFC Harrow. The following table indicates the weed species and the locations where research takes place.

Species	Guelph	Ridgetown	Harrow
Annual sow thistle		√	
Beggarticks		√	
Bur cucumber		√	
Canada fleabane	√	√	√
Canada thistle		√	
Cocklebur		√	
Common chickweed		√	√
Crabgrass		√	
Dandelion		√	√
Eastern black nightshade			√
Goldenrod		√	
Field horsetail.		√	
Field violet	√	√	
Horsenettle		√	
Perennial sow thistle		√	
Prickly lettuce		√	√
Proso millet		√	
Quackgrass	√		
Red top		√	
Sandbur		√	√

Spreading atriplex		√	
Swamp smartweed		√	
Three seeded mercury	√	√	
Tufted vetch	√		
Volunteer corn	√	√	√
Volunteer hemp		√	
Wirestem muhly		√	

Gaps/Barriers/Deficiencies

As such, the information generated is very useful for end-users. It is necessary however to find means to effectively channel the information to end-users while taking into account he limitations imposed by herbicide labels.

Nevertheless, there is a need to develop a database on the best ways to control these species in the major field crops of Ontario. Although herbicides would be the management tools of choice, strategies should not be exclusive and should encompass other approaches such as mechanical and cultural. Management strategies should aim at developing long-term solutions and avoid short-term "Band-Aid" approaches that could create further problems. This means that the biology of the problem weeds should be the aim of those studies at its understanding forms the base of long-term, integrated solutions

This type of information is lacking for most of those species. The fact that, as a whole, weed management in Ontario is rapidly evolving needs to be taken into account. The availability of technologies such as Roundup-Ready and Liberty Link can bring solutions, but can also be the source of new concerns. While herbicides such as glyphosate, glufosinate and others can provide adequate control of problem weeds, care should be taken to avoid overuse so the mistakes of the past are not repeated.

4. Development of Integrated Weed Management (IWM) systems for field crops. Ontario Weed Committee

The issue

Past experience in Ontario and elsewhere has proven that reliance on herbicides as the sole means to control weeds can cause problems such as the development of resistance, shifts of weed community composition, over-application of herbicides, and accumulation of residues in the soil. IWM systems aim at reducing the negative effects of weed management, preserving efficiency in weed management while taking into account environmental and societal needs.

IWM works by destabilizing weed populations and shifting the weed-crop interference equilibrium in favour of the crop so as to maximize yields and quality. Herbicides are integral parts of IWM systems along with cultural, mechanical and biological methods. Yet, IWM does not simply mean mixing different methods together in the hope that better results will ensue. IWM needs not be reactive to problems but rather predictive and proactive. Knowledge of weed thresholds, critical periods of interference, weed germination/emergence patterns, etc., are biological information that is critical for IWM systems.

Current Research/Extension Activity

Research on modeling of weed emergence is currently being conducted at the University of Guelph. Evaluation of the effect of row width, crop density and tillage management on weed seed predation is done at the University of Guelph. Experiments on critical period of interference in no-till soybeans are conducted at AAFC Harrow. Research on the effect of weed threshold based decision support systems is being conducted as a joint effort between AAFC Harrow, University of Guelph Ridgetown and Guelph campuses.

Gaps/Barriers/Deficiency

More long term studies, comparing different approaches to IWM so as to demonstrate/prove their effectiveness, are needed. Limitation in funding for long term research is a severe problem for that type of research.

5. Developing sustainable soybean production systems – Ontario Oil and Protein Seed Crop Committee.

Significant improvements have been made in the yield potential of soybean varieties. This improvement has been made with little attention to changes in production practices. Research is required on production systems involving improved varieties. Environmental pressures are shifting production practices towards minimal application of herbicides, fertilizers, or pesticides. Reduced tillage could result in a 30-35% saving in land preparation costs and narrow rows may increase yields 5-10%.

Background: Over the past 15 years significant changes have occurred in Ontario soybean production practices. Four of the principal trends are as follows:

1. Increased acreage- the total soybean acreage planted has increased significantly over the past 15 years. This resulted from expansion of the soybean producing area in the north and east and reduced rotation in traditional growing areas.

2. Narrower rows- Soybeans were traditionally grown in 30-inch rows but the majority of soybeans within the province are now grown at a variety of row widths below 25 inches. Narrow rows affect the climate within the crop canopy and can have an effect on weed populations and foliar and root diseases.

3. Reduced tillage- Soybeans are readily adapted to a variety of tillage practices. The development of no-till seed drills has facilitated reduced tillage for soybeans especially in the shorter season areas of the province. Production difficulties have occurred with reduced tillage on fine textured soils. The causes of these difficulties have not been identified. Soil structure, soil moisture, and plant diseases may be factors.
4. Reduced rotation - Soybeans are included more frequently in crop rotations especially in southwestern Ontario. The effect of this practice on soil structure, fertility, weeds and diseases requires additional research.

6. Agronomic Technologies and Environmental Impact – Ontario Cereal Crop Committee

Background: Research developing and evaluating new agronomic techniques is essential to determine strategies which will maximize returns for growers and processors, yet minimize or remove any environmental impact. These technologies are far ranging in nature, from fertilizer rates, placement, and timing to tillage techniques. This is a high priority for public funding as there is little impetus or benefit for private research in this area.

Where appropriate, environmental aspects of these technologies should be an integral part of the research undertaken. An excellent example of this type of research would be the investigation of nitrogen rates for higher protein wheat production. The research could determine appropriate nitrogen rates, predictive tools like the nitrogen soil test, use of combine protein monitors, value to the end user, and also investigate any environmental impacts on groundwater.

Economic importance: The cost of tillage and other inputs makes up a large part of the cost of production of cereal crops. Reduction of these costs, or increased efficiencies of inputs, would have a positive economic impact on all producers.

Competitiveness: Increased efficiencies or reduced costs will allow the industry to be more competitive.

Environmental: Targeted applications and increased efficiencies will reduce environmental impact of agronomic practices that are investigated.

7. Managing Climatic-related Risk in Perennial Forage Crops – Ontario Forage Crops Committee

I) Genetic/Biotechnology Improvements with respect to winter survival

II) Develop management techniques for improved winter survival of conventional and genetically altered alfalfa, and develop management techniques to enhance production of grasses during drought conditions.

Background:
Perennial forages occupy more farmland than any other crop in Ontario. They provide the feed base for virtually all dairy, beef, sheep, goat and horses farms. Winterkill can range from no significance to severe losses in all areas of Ontario. Clearly variety selection and management have a resounding influence yet producers are still concerned and always fear another bad winter will result in a shortage of hay and higher prices. Since a secure supply of forage is critical to the operation of these industries, the OFCC feels that researchers have to concentrate more effort on methods to ensure that forage supply will be adequate.

Forage and livestock producers have stated quite clearly that climate-related issues, especially winterkill of alfalfa are their number one concern. Genetic progress in alfalfa over the past 20

years has focussed on disease resistance, increased yields and improved quality. However, specific efforts are required by conventional or biotechnology means to improve winter hardiness of alfalfa without deterring from other traits, especially yield, that have been improved in the past. To complement this work, improvements in the winter hardiness of orchard grass should be made, since this grass is increasing in use with alfalfa and is the key grass species used in sown pastures in much of the province.

In addition to genetic improvements, producers want management techniques that improve the continuity of forage supply over the growing season. This would include techniques in pasture management to even forage supply during spring and summer, cope with dry weather and extend the grazing season in the fall. Certain annual forage crops have potential to produce pasture or stored forage when the growth of perennial forages is reduced by drought or the onset of autumn. For stored forages, efforts should be concentrated on ensuring that management techniques are properly matched with the needs of new genetic material introduced into the marketplace. When new traits are introduced to alfalfa or other species, the management package may need to be re-evaluated. In other cases, what is considered normal management may need to change to better ensure winter survival of currently used varieties.

The OFCC recommends that research be directed at ensuring the security and continuity of forage supply with respect to climate related risk through improved genetics and management practices.

8. The management/impact of herbicide tolerant crops in a sustainable cropping system – Ontario Oil and Protein Seed Crop Committee

The uptake by producers in growing herbicide tolerant crops is phenomenal. Along with this technology come concerns with weed resistance, weed population shifts, and control of herbicide tolerant volunteer plants in following crops.

Background:

1.It is estimated that 50% of the soybean acres in Ontario this year will be tolerant to glyphosate..
2.Herbicide resistance has been identified in overuse of other herbicide groups (notably group II resistant weeds in soybeans)
3.Continued use of 1 herbicide in a relatively narrow application window may lead to shifts in weed populations within a species (i.e. late emerging vs. early emerging by herbicide solution.
4.Growing herbicide tolerant crops decreases the available options in controlling volunteer plants in succeeding crops (i.e. cannot remove RR canola out of RR beans with Roundup)
5.The concerns with overuse of 1 herbicide group in a cropping system with all crops tolerant to that herbicide group.
6.Some weed escapes adversely affect the quality of the harvested crop (i.e. nightshade staining in soybeans). This is of particular concern in the food grade market.

9. Sustainable Production Systems - Ontario Pulse Committee

Issue Development of agronomic Practices that utilize innovative technologies, enhance sustainable production and exploit the yield potential of new cultivars. Agronomic research is also focusing on practices that enhance food quality and food safety.

Details

Research is required to maximize production with less tillage, narrow rows, cover crops, and minimum herbicide, fertilizer, and pesticide. Reduced tillage could result in a 30-40% saving in land preparation cost. Further work on nitrogen management options need to be explored. The market place is placing increasing emphasis on food quality and food safety issues requiring research and field evaluation of practices that influence these.

Background

One theme during the past several years of research has focused on seed quality and food safety. Mechanical damage study work has been carried out to genetic differences in susceptibility to mechanical damage. Research and extension has also evaluated how desiccants influence yield, and quality of edible bean seed. Further research into agronomic practices and their influence on seed quality and safety is required. Edible beans, particularly coloured beans are grown in wide rows using conventional tillage with the result that plant growth may only cover the soil for two months out of the year. Reduced/no-till options need to be further explored to improve sustainable production. In addition, earlier research trials have shown mixed results with nitrogen fertilizer. However, growers often report an advantage in applying 40-80 lbs./acre of nitrogen. Nitrogen management needs to be further explored including, N soil testing system, and use of inoculants to minimize potential for environmental loading.

Research Recommendation. Important, further funding required.

10. Forage Preservation and Storage – Ontario Forage Crops Committee

Forages in Ontario are either made into stored feed as dry hay, silage, or grazed. In stored feed systems, many losses occur from the standing crop to offering the stored feed to the animal. Attempts to minimize these losses have been the subject of previous research projects in Ontario and elsewhere. New efforts in equipment design may further reduce losses during forage preservation.

The goal of making "hay in a day" has been expressed by commercial hay producers. Such a system might incorporate hay maceration plus preservatives, or microwave hay drying. Hay maceration is being studied in Quebec and in western Canada, while work on preservatives is widespread, although mostly in the private sector.

In the area of storage, much knowledge is available and extension is likely the key to progress in this area.

11. Forages and the Environment - Ontario Forage Crops Committee

Forages are generally quite beneficial to the environment. Studies in the past have shown improvements in soil structure, reduced soil erosion, and less runoff from fields with a perennial forage cover. New issues have arisen which need to be addressed. The use of forages as buffer strips along watercourses is common, but it is unclear what type of forage works the best or how large the buffer should be. The use of forages as a crop to store carbon in the soil is also an issue that seems likely to increase in prominence over the next few years. As the concept of full accounting gains prominence (including indirect costs of a practice or activity), the beneficial nature of forage crops on the soil, water and air could increase their value in modern crop production systems.

Another societal benefit associated with forages is the value of having livestock grazing pastures. In some parts of Europe, farmers are paid to maintain livestock on certain pastures because it increases the value of the area for tourism. While outside the scope of the OASCC system, it is reasonable that we should acknowledge the non-agricultural value of grazing livestock in the same way that we acknowledge the value of forages for soil quality and carbon sequestration.

A potential negative association between forages and the environment is the large volume of waste plastic that is generated each year from wrapped or bagged silage. It is imperative that more effort is put into recycling waste silage plastic or into creating biodegradable or photodegradable plastics that will not require land filling.

12. Weed Management in Forage Crops – Ontario Forage Crops Committee

Background:

As in any crop, weeds are ubiquitous in forages. During the life of a forage stand, weeds can reduce yields, affect hay drying and reduce palatability. Weeds such as witchgrass in timothy or black medick in birdsfoot trefoil and red clover fields grown for seed can make seed cleaning difficult which affects the acceptability and quality of the seed. In pastures, weeds that invade the desired forages limit productivity and carrying capacity. As well, some weeds in pastures may lower animal productivity due to toxic compounds, prickles that scratch the throats of grazing animals, weeds that impart foul odour or taste to milk and structures like burrs that cling to wool. Weed management is an integral part of overall crop management because weeds have a profound effect on productivity and feeding value. The importance of weeds in forage management is such that it needs to be specifically addressed. Forage producers are concerned with controlling the annual broadleaf and grass weeds at establishment that can impede successful implantation of the stand. Another issue of major importance is control of perennial weeds such as dandelion, quackgrass, smooth bedstraw and Canada thistle. Weed management has an impact on several other areas deemed as priorities such as yield, environmental benefits, forage crop longevity, feeding value and grading system.

Research needs: Research efforts must continue to address the effects of weeds on yield, stand longevity and forage feeding value. The environmental impact of various weed management

methods for forage crops should be assessed. In addition to investigating weed management in forages, work should also be conducted on using forages as a weed management option.

- The problem of weeds at stand emergence still needs to be addressed. Some of the commonly used broadleaf herbicide products restrict grazing or feeding of the forage in the year of treatment. The manufacturers are working toward removing that restriction. New formulations of products are currently under test and should continue to be monitored.
- New products, tank mixes, adjuvants, rates and application methods must continue to be evaluated to provide forage producers with as many options as possible to control weeds at all stages in the life of a stand.
- Continued investigation is needed into integrated approaches to weed control in hay, pasture and seed crops focussing on cultural, mechanical and chemical methods. Additionally, the role of forage species, mixtures, varieties, seeding rates and dates as means of cultural control is necessary given the expanding uses for forage crops and the introduction of new forage species.
- Using forages as cover crops, inter-crops and living mulches in other crop and non-crop situations is another aspect of weed management that would promote work on forage varieties and environmental benefits.
- The effects of weeds on forage feeding value in terms of nutrients and palatability should be assessed.
- Identification of new emerging weed problems in forages, their impact on productivity and options for their management is important.

13. Evaluate effectiveness of new herbicides to assist registration and provide information on environmental impact - Ontario Weed Committee

The issue

The introduction of new herbicides by agrochemical companies has been increasingly difficult over the past decades. This is due to increased R&D costs, increasing stringency in registration requirements and depressed value in the agricultural sector. It is therefore of prime importance that any potential new herbicide is widely tested across the province and that this testing is not conducted only by the companies developing the products. The fact that some of the data that supports registration is obtained at arms length form the companies can be a reassurance for end-users that the information is as correct as can be.

Current Research/Extension Activity

Research on the evaluation of new herbicides is on going at the University of Guelph (Guelph, Kemptville, Ridgetown) and AAFC Harrow.

Gaps/Barriers/Deficiency

Agrochemical companies sponsor most of the research that is conducted by the public sector. They will look for specific use patterns as dictated by registration requirements and forecasted market placement. Independent assessment allows for the examination of use patterns of interest that might be overlooked by the companies.

14. Soil Fertility/Soil Quality/Soil Management – Ontario Oil and Protein Seed Crop Committee

Issue: Optimizing crop production while protecting soil and water quality

Residual fertilizer P has been increasingly becomes a concern as to farmers' return and the impact on water quality. Continuous fertilization with a use efficiency as low as 15-20% in the year of application has resulted in large accumulation of phosphorus (P) in soil. In Ontario, about 60% of soils for agricultural production are with high or excessive soil test P levels. Further, adoption of reduced tillage, especially the no-tillage practices, has resulted in stratification of phosphorus and potassium, which are predominately staying in the surface soil layer. This distribution pattern of nutrients induce roots mainly located in the surface layers, and thus decrease the resistance of crops to the adverse conditions, such as periodical drought. Values of residual P and K need crucially to be determined and innovative fertilizer P and K application method need to be developed and evaluated. Very limited study on residual K effect was done in the U. of G, which has been unfortunately almost discontinued. No research is going on phosphorus as to the issue mentioned above.

With the increased phosphorus level in soil, no-point source pollution from agricultural soils has been a concern on water quality. Knowledge gap exists as to the effects of soil phosphorus management needs to be filled. Some studies have been done in Quebec, which, however, in Ontario is very minimal or close to nil. Soils with high or excessive soil test phosphorus levels are with a larger area in Ontario (60%) than in Quebec (44%). Data shortage has built up significant obstacles for the implementation of the nutrient management plan.

During the past several years, a significant body of medical research has recognized soybeans as having a potential role in the prevention and treatment of chronic diseases (cancer, heart disease, kidney disease, and osteoporosis). These effects have been attributed to photochemical called isoflavones, which are present naturally in soybeans and soy products. Recent preliminary studies at GPCRC, AAFC, Harrow, have uncovered that there are substantial differences in isoflavone levels in some Ontario soybean varieties, which are significantly affected by the application of fertilizer phosphorus and potassium. The best soil fertility management practices have to be developed in association with varieties, if quality soybeans are to be produced and farmers' profits maximized.

15. Reducing Production Risks - Ontario Cereal Crops Committee

Background: Control of risk factors is critical to ensure a stable supply of sufficient quantity and quality of cereal crops. Factors such as winterkill, fusarium, sprouting, rust and other problems can cause havoc with both quantity of product available, and quality to meet market requirements. Techniques and strategies to overcome or manage these risks would have a huge positive impact on the stability of the industry.

Examples of research which fits in this category is the development of the fusarium prediction model, the rust monitoring model, improved winterhardiness techniques, and others.

Economic impact: Risk factors are responsible for many of the critical situations that occur in cereals. If techniques can be developed to overcome these risk factors, the added stability of supply should have huge economic benefits, not only to producers but throughout the processing sector.

Competitiveness: Consistent supply of quality product will allow the sector to out compete other competing jurisdictions.

Social benefit: Consistent supply will allow stability for jobs involved with the sector.

16. Determine weed specific postemergence herbicide rates and critical factors affecting their performance. Ontario Weed Committee

The Issue

There is a perception that herbicide label rates are sometimes too high than what should be required to obtain adequate control on specific weed species. Requirement for herbicide labels include a built-in safety factor that takes into account wide weed spectrum (a range of different species) and variable environmental conditions. The fact is that herbicide doses could be tailored so as to take into account the susceptibility of specific species. In many instances that tailoring would result in significant reduction from the label rate, without sacrificing efficacy. This information will help growers minimize herbicide use by adjusting the dose to the particular weed problem.

Current Research/Extension Activity

Work on weed specific postemergence herbicide rates for corn and soybean s is currently being done at AAFC Harrow. Related work on herbicide rates in corn is conducted at the main campus of the University of Guelph.

Gaps/Barriers/Deficiencies.

Such data will be inherently variable and this variability will need to be assessed before recommendations are to be made. Variability comes from two main sources:
1: the fact that environmental conditions have a strong impact on herbicide performance, especially when doses are reduced;
2: there is variability among weed populations across the province that warrants this type of investigation to be conducted on a larger scale.
The above mentioned sources of variability need to be documented further.

17. Construct a database of herbicide use histories/patterns and occurrences of herbicide resistance in Ontario to aid in the development of resistance management guidelines. Ontario Weed Committee

The Issue

Resistance to Group 2 herbicides (ALS inhibitors) is rapidly developing in weeds in Ontario. It has appeared in 1997 in green and redroot pigweed and has been confirmed in 2000-01 in Eastern black nightshade and common ragweed. Group 2 herbicides comprise the sulfonylureas

(thifensulfuron, Classic), the imidazolinones (imazethapyr, Pursuit) and the triazolopyrimidines (flumetsulam, Broadstrike). These herbicides have favorable features such as low mammalian toxicity, low use rate, good crop safety and high weed control efficacy. Resistance renders these herbicide(s) inefficient on the affected weed populations and very often force farmers to resort to re-spray programs. Eventually, this may force growers to use alternative herbicides with less favorable characteristics.

Research/Extension Activity

Research is being conducted at the University of Guelph (Guelph campus) on characterizing resistance in green pigweed, redroot pigweed, Eastern black nightshade and common ragweed. The Herbicide Resistance Subcommittee of OWC is currently devising recommendations for the management of resistance that are based on current research information.

Gaps/Barriers/Deficiencies

Eastern black nightshade and common ragweed need to be further characterized so that alternative herbicides can be identified.

Farmers and consultant need to be able to rapidly identify resistance through the use of reliable diagnostic tests. Rapid confirmation eliminates second-guessing and allows early planning of management strategies. It also allows for the identification of reliable alternative herbicides, preventing the costly use of inefficient rescue treatments.

The link between resistance and potential fitness penalties associated with it need to be investigated further. What is the effect of resistance when alternative herbicides are used? Would resistance genes affect survival in the seed bank? This need to be determined on a weed specific basis so as to help in the better design of management programs.

There is a need for the development of comprehensive management tactics to deal with resistance and to prevent its occurrence. Ideally these should be based on the adoption of Integrated Weed Management programs that would proactively target weed problems and not just react to the occurrence of resistant populations.

18. Develop and evaluate site-specific methods of weed management as a means of reducing weed control costs and/or improving efficiency - Ontario Weed Committee

The Issue

Site-specific weed management targets only those areas of fields where weed problems occur with an emphasis on weeds with patchy distributions. It has been shown that it is possible to effectively target weed patches thereby reducing herbicide use by up to 60%.

Research/Extension Activity

Research is currently done at the main campus of the University of Guelph for the development of a sprayer capable of detecting weeds and triggering herbicide application.

Gaps/Barriers/Deficiencies

A major barrier preventing the adoption of this approach is the difficulty in obtaining precise and reliable weed maps in a quick and inexpensive manner. Remote sensing technology is seen as potentially being able to provide this kind of information, but we need to understand the limitations of this technology. More importantly we need to determine what resolution needs to be achieved in the detection of weeds.

As this approach target weed patches, we need to increase our understanding of weed patchiness. Why are weeds patchy? Are patches stable, allowing maps to be reused over the years? Can we predict patch expansion? What is the effect of targeting patches on the overall field dynamics? What would happen to weed threshold if patches are targeted? These are only few of the questions that need to be answered so that the technology that will be used will be based on sound biological principles.

19. Determine the effect of varying nitrogen rates in corn on weed competitive ability, weed seed germination patterns and the effectiveness of control measures on species such as foxtails, barnyard grass, pigweeds, lambsquarters and common ragweed - Ontario Weed Committee

The Issue

It is very likely that government regulations will impose limits on the amount of N fertilizers farmers will be allowed to put on crops, especially on coarser textured soil. As N is the nutrients for which weeds compete the most with corn. Therefore a reduction in fertilizer levels may negatively impact on the outcome of the weed-corn competition, to the disadvantage of the crop. This may, as a result, mean that weed control measures need to be intensified. The effect of reducing N levels on the ability of crops to withstand competition deserves to be looked at.

Research/Extension Activity

Research is done at the main campus of the University of Guelph to investigate the effect on N level on the competitive ability of green foxtail and corn

Gaps/Barriers/Deficiencies

No research is currently done to study the effect of varying N level on the competitiveness of other species such as common ragweed, lambsquarters, pigweeds, and barnyardgrass

20. Integrated Pest Management for Insects and Disease – Ontario Pulse Research and Services Committee

Details Leafhoppers are important insect in edible beans for which up to 3 applications are required for control in a season. Research work conducted by Ridgetown College, University of Guelph with seed treatments indicates excellent early season control, which may replace/reduce the need for sprays. Differences in tolerance/resistance factors of various bean types need to be investigated. Research/extension efforts are required to develop IPM program

Registration of a new seed treatment, Maxim – Apron on edible beans has been submitted for very early season control of root rot organisms. Registration of this product will allow freer

trade of edible bean seed between Canada and the USA, where this seed treatment is already registered. Further research is required with seed treatments including biological products along with agronomic practices to manage root rot.

Background

Evaluation of New Seed Treatments for Root Rot

This research was initiated in 1998, and the primary focus is to identify new seed treatment products that provide better visual control of root rot, and provide a significant yield increase, compared to control treatments. In 2000, several new seed treatments were tested. As well, the seed treatments were tested for the control of seed borne anthracnose, in a greenhouse study. In the field studies in 2001, emergence and root rot varied with location, in part due to varying levels of root rot organisms. This year a new method of inoculating plots with root rot organisms within plots appears to be quite effective. Further investigation of this methodology is required. Most seed treatments improved emergence compared with the checks. Limited testing with several biological products including bacillus subtillus show varying levels of control.

Evaluation of New Seed Treatments for Leafhoppers

A combination of higher leafhopper pressure in recent years, and greater grower awareness of leafhopper damage has resulted in an increase in spraying to control leafhoppers in edible bean crops. Most growers that monitor their fields closely find that they spray as many as three times each crop year. It was felt that some of the new insecticide seed treatments may provide some residual control of leafhoppers, with would reduce the need to spray. After 2 years of trials, the initial data suggests that leafhopper nymph populations can be kept below an economic threshold for up to 6 weeks after planting. In some cases yields where seed treatment was used were up to double that of the non-treated check. Cost of the seed treatments are less that ½ of the cost of one pass of field spraying. In 2001, another project was initiated to investigate other agronomic practices to manage leafhoppers. One bean type, Burma is very susceptible to leafhoppers, but showed limited value as a trap crop when planted next to other bean types.

Research Recommendation Important, continue funding at existing level

21. Winter Canola Development – Ontario Oil and Protein Seed Crop Committee

Issue: Developing Winter Canola for Ontario

Improving the productivity of canola in Ontario requires research in the following areas:
1. Ontario growers need a program develops improved varieties and also which identifies the best hybrids and varieties coming from Western Canada, Ontario, and other countries.
2. Agronomic studies to determine nutrient requirements, efficient tillage systems, cropping systems, and varietal response to no-till.
3. Controls to reduce damage from insects (flea beetles) and disease (black leg, Alternaria and white mould).

4. Increase winter hardiness of winter canola.

Background: The spring canola crop is worth $12 million per year in Ontario. The prospect of inexpensive, broad-spectrum weed control, higher yielding varieties, $400/tonne prices and an available market make this an attractive cash crop for the short-season areas of Ontario in which growers have few cash crop options. However, canola has had little agronomic research in Ontario. Studies designed to: i) determine the nutrient requirements of high yielding requirements hybrids, ii) test more efficient planting systems such as no-till and iii) varietal response to no-till, iv) develop methods of controlling damage from flea beetles and Sclerotinia. In 1996, herbicide-tolerant canola varieties were available, yet little Ontario research has been done on cropping systems. Some data suggests that a glufosinate-tolerant variety is very susceptible to Alternaria. This could cause major problems if this variety is grown in the presence of the disease of the disease. Research is also needed to pinpoint when canola should be sprayed to maximize weed control, and yet not miss late-emerging weeds.

There is also a major need to extend the winter hardiness of winter canola. This likely means incorporating transgenic characteristics. If the crop would survive across southern Ontario, it offers 30% higher yields than spring canola, over winter erosion protection, a better distribution of seasonal workload for the growers, better canola quality, and harvesting in July.

22. Pest management Strategies - Ontario Tobacco Committee

1- Fungicide screening for damping-off of tobacco caused by *Rhizoctonia* solani

The fungicide Benlate is currently used to control damping-off of tobacco, caused by the phytopathogenic fungus, *Rhizoctonia solani* and is the only pesticide approved for this use in Canada. On April 19, 2001, the manufacturer of this fungicide, E. I. Du Ponte de Nemours and Co. announced that this product would no longer be available for sale by the end of 2002. Alternative products must be tested for their efficacy and their suitability as potential replacements of Benlate for controlling this widespread problem.

2- Development of fungicide replacement, millet or other nematode suppressing crops to control nematodes.

Reduced tobacco yields in southwestern Ontario due to the root-lesion nematode (*P. Penetrans*) has increased reliance on fumigant nematicides. However, fumigants are costly and their use present environmental concerns. Cost effective and environmentally friendly biological control measures are needed in order to effectively manage nematode populations below economic threshold levels. A rotation system including crop plants that are poor host for root-lesion nematode may offer a sustainable approach.

3- Fungicide screening for control of metalaxyl insensitive blue mold.

Blue mold is a serious concern to most tobacco growers in Ontario. When the disease pressure is high, both yield and quality are severely affected. In order to properly control the spread of the disease, it is important to evaluate compounds for control of blue mould on flue-cured tobacco

and to study the effect of these compounds on the quality of the tobacco, regarding chemical composition, agronomic and smoke taste characteristics and residues within the cured leaf.

4- Evaluation of control measures for control of bacterial soft rot and *Aspergillus*.

Bacterial soft rot and Aspergillus have been identified as a recurring problem during mid to late season tobacco production in Ontario. These diseases are capable of rapid spread during flue curing, especially in stick kilns, causing large losses in harvested products and degraded product quality.

5- Fungicide screening for greenhouse and field control of target spot.

Since the identification of the disease in 1994, it has occurred in widespread locations throughout the Ontario tobacco belt. Occurrences of this disease on a widespread, regular basis will likely decrease yield and quality of tobacco, particularly on the lower part of the plant where the disease is likely to be most severe. To minimize the occurrence of the disease, it is important to evaluate compounds for control of target spot disease on flue-cured tobacco.

6- Screen insecticide for control of wireworm, seed born maggots on tobacco transplants.

Although in recent years no single insect has caused devastating losses in Ontario fields of flue-cured tobacco, in the absence of effective insecticide screening and management programs, several insect pests can emerge and certainly reduce yield and quality of the crop.

23. Improving crop management - Ontario Tobacco Committee

1- Further develop float/dry tray systems for producing seedlings with emphasis on i) pest management (damping-off and disinfecting), ii) hardening-off, and iii) uniformity.

Unheated greenhouse beds, seeded to a density of approximately 100 to 120 seedling per square foot, normally provide excellent seedlings for transplanting. However, because of the labour concern for pulling plants for transplanting and for the transplanting process itself, tobacco growers are moving towards a less labour intensive seedling production. The float/dry tray systems may be a solution for some growers, however a study needs to be conducted to investigate these systems for producing seedlings in relation to pest management, hardening-off, and uniformity.

2- Evaluate sucker control products with improved efficacy and lower usage rates than those used currently.

Sucker control in flue-cured tobacco is one of the most important practices without which both yield and quality are adversely affected. Several chemical control measures are available that may be applied before and after topping. However, most growers are not satisfied with the efficacy of these products. Therefore, new products with improved efficacy and lower usage rates than those currently used need to be evaluated.

Recommendation 2

Innovative and Enhanced Germplasm Development and Utilization.

This section will include crop breeding, performance evaluation, physiology and the development of new molecules, gene discovery, genomics, and bioinformatics to produce knowledge and materials to advance the industry.

The research described within this recommendation strives to develop the raw materials and the knowledge base leading to a vibrant and diverse field crop sector. It includes breeding for increased competitiveness, new markets, life-science based products and processes and improved quality. It includes basic research in the areas of genomics and bioinformatics to discover new applications and uses, to increase efficiencies of breeding systems and to dramatically broaden the utility of basic commodities. The overall goal is to produce new, higher value products for the industry and to do it quickly and more efficiently. The priorities listed also include research programs in the area of crop and plant physiology and document strong support for enhanced performance testing systems.

1. Breeding for yield and production stability – Ontario Oil and Protein Seed Crop Committee

Issue: Maintaining competitiveness in international soybean commodity markets.

Soybean is an extremely important field crop in Ontario with an economic farm gate value in excess of $500 million/year. Plant breeding results in significant increases in productivity and economic gain, without significant increases in production inputs. In Ontario, for each 1% gain in yield potential, farm gate value increases by over $6 million at current acreages (2.1 million), and average price ($7.50/bu) and yield (38 bu/ac).

Background: Soybean productivity in Ontario is increasing at approximately 1.5%/year due to improved cultivars and superior production techniques. At this rate of increase, the soybean crop will be worth $696 million (in farm gate receipts) at the end of a 10-yr period. This is a farm gate payback of over $500 million over this 10-year period! Maintaining the current rate of gain will require a greater contribution from plant breeding. The amount of emphasis that can be allocated to breeding for yield depends upon the number of other traits that must be considered. Breeding for resistance to soybean cyst nematode and white mould and breeding for specific end-uses, such as food quality for export markets (tofu, natto, soymilk, miso) and in value-added fatty acid profiles in the oil is also important to Ontario soybean production. Emphasis on breeding for other targets will pressure the gains that can be achieved in increasing the yield potential. Resources must be maintained or enhanced in breeding for yield to maintain the current rate of yield gain. With a reduction of just 0.5%/year the Ontario producers would lose more than $130 million over the next 10 years and using the 5:1 multiplier ratio, the entire soybean industry $650 million less.

2. Genetic Improvement of Corn for Ontario – Ontario Corn Committee

The existence of an efficient continuum from inbred development through to commercial hybrid evaluation is critical to the Ontario corn industry. Elite germplasm may be developed to increase productivity, meet specific needs of a bio-based industry, or to confer nutritional improvements. However, these advances will have little impact on the provincial economy unless a system exists for ensuring that these advances can be integrated, refined and tested across Ontario.

Many of the priorities for the corn industry depend upon the successful incorporation of genetic traits, natural or modified, into superior breeding lines (e.g. cold tolerance, pest resistance, premium market traits, etc.) Although there are large hybrid development programs in the private sector, inbred/hybrid development must also continue to be part of the public breeding programs, since it is only through locally adapted germplasm that the true value of genetic enhancements to corn growers can be properly evaluated.

Within Ontario these public programs are important sources of "early" germplasm to be fed into the private sector breeding programs and they serve as the backbone for identifying the most efficient commercial hybrids.

3. Enhanced Pest Resistance in Corn - Ontario Corn Committee

Fusarium

Corn grown in Ontario continues to be prone, periodically, to severe infection by Fusarium ear rots. The toxins produced by these moulds seriously affect the performance and health of hogs, in particular, and may also affect the performance and/or health of other livestock, and humans. Livestock feeds still represent the greatest usage of corn in Ontario and the usage of corn for human consumption is increasing. Thus, high priority must continue to be given to the development of corn lines with resistance to Fusarium ear rots.

Work at ECORC and University of Guelph have investigated the mechanisms of ear rot infection and identified sources of resistance. Continuing funding is needed, however, to assist with the incorporation of genes for resistance into breeding lines and then into commercial breeding material, using both conventional breeding methods and biotechnology.

Leaf Diseases

In recent years there has been a substantial increase in the use of cultural practices that leave higher levels of crop residues on the soil surface throughout the winter and subsequent growing season. The presence of corn residues on or near the soil surface increase the risk and/or severity of infection from various fungal leaf diseases, such as eyespot, leaf blights and rust. In addition, leaf diseases not currently present in Ontario are threatening to move into this province from adjacent States in the USA. Hybrids currently grown in Ontario may have little resistance to these diseases.

Sources of genetic resistance to leaf diseases need to be identified and rapidly incorporated into superior inbred lines, using both traditional breeding methods and biotechnology. Success of

this breeding effort and the prevention of devastating disease infestations will require the support of a plant pathologist with expertise in corn diseases.

4. Development of biotechnology tools for use in breeding and to provide understanding of genetic control of traits – Ontario Oil and Protein Seed Crop Committee.

Issue: New tools must be developed to understand and assist in breeding for complex traits

Biotechnology and genomics research offers new opportunities for soybean crop improvement. Conventional breeding programs and the processing/distribution chain will increasingly rely on molecular markers for selection of complex traits, for stacking multiple traits especially disease resistance genes, as well as for cultivar identification. The following are priority areas in molecular mapping, structural and functional genomics:

a) Mapping of qualitative and quantitative traits using DNA markers
b) Determining gene function and identifying novel genes
c) Determining the structure and organization of the soybean genome

Background

The current explosion of DNA sequence information coupled with recent advances in molecular-based technologies offer new opportunities for soybean improvement. Large, publicly available databases of soybean DNA sequences, in the form of 'expressed sequence tags' (ESTs) and full-length cDNA sequence, are new and powerful resources for identifying genes that determine traits. Presently, a limitation restricting the use of marker assisted selection in breeding programs is that the function of most genes and their relationship to agronomic traits remains unknown. There is also a need for more precise genetic maps with a greater density of DNA markers. Thus, it is a priority to develop high-resolution genetic and physical maps of the soybean genome and to link genes to discrete functions and traits. Developing and maintaining recombinant inbred populations segregating for specific traits, and screening for germplasm diversity provide resources for gene discovery. Creating cDNA and genomic BAC (bacterial artificial chromosome) libraries, assembling sets of unique expressed genes, constructing gene microarrays, and undertaking large-scale automated sequencing of DNA represent important enabling technologies for gene identification.

5. Improved Cold Tolerance in Corn – Ontario Corn Committee

This research area is key to enhancing competitive advantages for Ontario corn production as US based breeding programs have less interest in the genetics or physiology of cold tolerance.

There is a distinct need to develop reliable techniques to assess tolerance of corn hybrids/inbreds to chilling during grain filling, and determine if chilling tolerance during grain filling is correlated to early season cold tolerance.

More information is required regarding the conditions that limit corn growth, germplasm that will prosper in cool conditions, and the relationships that exist between traits that provide superior performance under both warm and cool conditions.

Ultimately, the goal is to incorporate superior cold tolerance into superior lines in corn breeding programs.

6. Improving Feeding Value of Forages for Stored Feed and Pasture – Ontario Forage Crops Committee

I) Genetic/biotechnology improvements to energy content and/or other desirable quality traits.

II) Management of forage crops to optimise feeding potential

Background:

High quality forage is the engine that drives the dairy industry in Ontario. Similarly, the beef and sheep industries rely to a great extent on high quality pasture and hay to ensure both milk production and proper rebreeding. Efforts to increase quality in both stored feed and pasture must be made to ensure that increased animal performance can be achieved from forages.

Alfalfa is the main stored forage used in Ontario. It supplies adequate amounts of crude protein when harvested at the correct stage of maturity, but it is significantly lower in energy than grains such as corn or barley. Alfalfa that has been selected or genetically modified to have higher digestible energy content would allow it to fill a higher proportion of the ration for milking cows and thus reduce feed costs. Progress has been made in the production and assessment of alfalfa varieties with reduced NDF levels and increase cell wall digestibility. Another area of interest would be to modify the types of protein found in common forage plants.

High quality forage harvested as pasture can be a very economical method to feed beef cattle, develop beef and dairy breeding heifers, and grow market lambs. If these enterprises are to grow and prosper, more emphasis needs to be placed on managing the pasture resource to produce higher quality forage. Researchers need to focus on the forage quality requirements of the whole farm to integrate various methods and times of forage harvest into one complete system. Annual forage crops for stored feed or grazing should be considered here as well. The goal of the complete forage system should be to provide the maximum amount of nutrition from forages on a year round basis, supplementing with other feed sources only when the forage resource cannot provide those nutrients.

New species of forages need to be investigated for their ability to provide high quality forage in either pasture or stored feed systems. Before new types of alfalfa or other species are introduced to the marketplace, work should be done to ensure they can provide similar quality to existing material or else determine what management regime is needed to achieve the desired quality.

The OFCC recommends that research be directed at improving forage quality through genetic improvements, changes in management practices or evaluation of new species.

7. Control of diseases and nematodes – Ontario Oil and Protein Seed Crop Committee

Issue: Protecting soybean production from disease and nematode losses

Oilseed crops in Ontario are subject to relatively few diseases; however, disease losses have increased in the past ten years. Four or five important diseases require control to ensure sustainable consistent production. Chemical controls are environmentally and economically undesirable. The most effective way to control diseases of oilseeds and other field crops is through genetic resistance and effective management practices. The most important diseases of soybean in Ontario and estimated crop loss as a percentage of total production in 1994 are as follows: soybean cyst nematode (SCN) (0.80), Phytophthora root rot (PR) (0.50), Sclerotinia stem decay (SSD) (0.50), Rhizoctonia/Fusarium root rot (0.40) and pod and stem blight (PL) (0.20). These diseases accounted for approximately 65,250 tonnes in lost production or approximately $20 million. Although this loss is small compared to total production (2.9%), diseases can be devastating in certain areas and to individual growers. We -need further extension work to draw attention to SCN losses and promote management of this disease.

Background: Control of SCN will require resistance/tolerance and effective management practices. Resistance to SCN is complex and difficult to identify but considerable success has been achieved in the USA where SCN has been a major problem for 30 years. Long-term crop rotation with nonhosts and resistant or tolerant varieties provides the most cost-effective control. As SCN spreads to additional counties in Ontario and races change, a continuous effort in breeding for resistance will be required to ensure high productivity.

Considerable success has been achieved in controlling PR by developing disease resistant cultivars. Resitance genes can be identified and incorporated into soybean varieties by relatively simple screening techniques. However, the development of new races necessitates the continuous development of new varieties with tolerance and monogenic resistance.

Sclerotinia stem rot is increasing in importance in Ontario and the north central U.S.A. Varieties differ in tolerance to the disease but monogenic resistance has never been identified. This disease can cause severe losses but tends to occur sporadically. Crop rotation with nonhosts is recommended but once a field becomes infested with sclerotia (long term resting structures) the disease could reappear whenever conditions are favourable. Planting early varieties is effective in reducing disease severity and decreasing inoculum but growers are unlikely to accept an annual yield loss to control a sporadic disease. Full season, resistant/tolerant varieties and an effective management package could reduce the white mould problem.

Rhizoctonia/Fusarium root rot occurs in all soybean areas and soil types. Disease severity increases with plant stress caused by alternating wet and dry soil conditions. Most commercial varieties have at least moderate tolerance that was selected along with vigour and high yield.

New emerging or increasing threats are
a) virus causing seed coat discolouration transmitted by aphids
b) sudden death syndrome) fusarium wilt
d) root rots
e) increased seedling diseases in reduced tillage systems

8. Forage Yield – Ontario Forage Crops Committee

In the current situation, very little plant breeding work is being done on alfalfa or trefoil in the province. In other legume species and in the grasses there is no varietal breeding effort at the present time. Most alfalfa varieties on the recommended list are now coming from one of five breeding programs in the United States. In all other species new varieties are random arrivals from any other temperate agricultural part of the world. In other words the competitive advantage of Ontario's forage industry in terms of superior varieties is largely a lottery of arrivals.

It is a concern of the OFCC that so little effort is directed at improvements in the yield of forages being grown in the province. Clearly advances have been made from multiple pest resistance in alfalfa to improvements in winter hardiness of red clover. Some varieties have been truly outstanding, such as Climax timothy released in 1947 and still on the list.... but is it time to reemphasize the importance of remaining competitive in all of the forage species? The grass-breeding program at the Ottawa station has been terminated. None other exists in eastern Canada.

9. Cultivar Development, testing and Genetic Improvement of White and Coloured Beans – Ontario Pulse Committee

Details the detailed objectives are listed in order of priority. cultivar release and germplasm improvement through intra- and inter-specific hybridization followed by conventional and biotechnology-aided selection methods.

1)Conventional breeding and performance testing of cultivars for:

- Yield and yield stability
- Quality traits including cooking and canning quality, seed colour and size, mechanical damage
- Agronomic traits including upright plant architecture, harvestability, row spacing, disease resistance, environmentally friendly production
- Improved yield potential with early to full season maturity and upright plant architecture.

-Cooking and canning quality acceptable for domestic and international trade,
-Increased resistance to common and halo bacterial blight, white mold and root rot diseases,
-Pyramiding resistance to anthracnose and bean common mosaic virus races prevalent in Ontario and other major genes controlling resistance to pests,
-Transfer of resistance to potato leafhopper to dry beans adapted to Ontario.

-Testing lines/cultivars in coop. trials to identify superior lines for registration and to generate performance data.

2)Application of biotechnology to improve efficiency in cultivar development through:

-Identification of RAPD markers linked to common bacterial blight resistance genes aiding molecular marker assisted selection

-Integrating selection methods based on molecular estimates of genetic distance with conventional selection techniques to accelerate simultaneous improvement of yield, adaptation, quality and pest resistance,

3)Germplasm improvement and utilization through:

-Multi-cycle intermatings of adapted and donor germplasm sources (within and between Meso-American and Andean races, and utilization of tepary bean and scarlet runner beans) to widen the germplasm base,
-Release of improved germplasm to breeders of private and public institutions.

4)Performance testing

Background: Edible beans are an important niche crop to the Ontario Agricultural economy. Over 75% of edible beans are exported. Public research is required to develop germplasm, and varieties that are adapted to Ontario's climate; and possess the quality traits required by the market place. Without a complete system of development and testing, the economic benefit to Ontario's economy will not be realized.

10. Performance Testing – Ontario Cereal Crop Committee

Background: Development of new varieties for Ontario conditions is paramount to a strong agricultural sector. Registration requirements have been reduced, in order to allow for a more rapid entry into the marketplace for varieties with special traits and/or higher yield potential. While entry of these new genetics is positive, evaluation of area of adaptability and other agronomic traits is essential to allow the industry to prosper. A strong performance testing system is the most efficient method of determining the best way to use new genetic developments. Without performance testing, it will be very difficult for the industry to move forward to the benefit of all.

Economic importance: The value of this system is difficult to determine. Conservative estimates place the increased production and quality potential at $20 million dollars annually.

Competitiveness: The identification of better yielding and area specific cereal varieties gives Ontario growers a competitive advantage to areas that do not have broad based, well designed performance testing systems. This leads to a more competitive milling and baking industry, as quantity and quality of needed products can be produced close to home, reducing transportation and storage costs.

Social benefits: Growers are less dependent on support programs with high yielding, premium quality crops. Further development of the handling and processing industry will be encouraged, leading to increased employment and prosperity.

Environmental benefits: Higher yielding crops sequester more carbon, add organic matter back to the soil, and help reduce potential erosion through improved soil structure and canopy effects.

11. Performance testing of soybean varieties – Ontario Oil and Protein Seed Crop Committee

Issue: Providing information for variety selection decisions

With the imminent loss of merit testing for registration of soybean varieties, even more emphasis needs to be placed on generating data which allows producers to make profitable variety decisions.

Background:

1. Registration with merit, coupled with performance testing has allowed producers to grow with confidence, new varieties suited for Ontario.
2. The consistent yield improvement came even though expanded acres came from new, shorter season areas of the province. This growth came with no yield penalty.
3. New varieties whether they are from conventional breeding or those with special traits derived from biotechnology, need performance data to succeed in the marketplace.
4. Producers can only explore new market classes successfully if there is unbiased performance data. Yield adaptability and potential premiums need to balance with a positive bottom line for the producer.

12. Continue and improve the Public System of Forage Variety Testing In Co-operation with Industry Stakeholders – Ontario Forage Crop Committee

Background:

The OFCC has been conducting unbiased evaluation of varieties for yield and persistence since the committee was established in 1956. The work was undertaken to: i) Identify the varieties which merit use by forage producers in Ontario ii) Provide relative performance information among forage varieties available in the marketplace, and iii) Provide data to Canadian Food Inspection Agency to allow the legal sale of these varieties. In 1991, the OFCC was the first provincial recommending committee to undertake quality evaluation of forage varieties in addition to yield performance.

Forage yields and quality samples are collected from OFCC registration trials at public testing centres. The OFCC worked with the Seed Trade and the Canadian Food Inspection Agency during 1997 to improve the system of support for variety registration. This allowed varieties that meet OFCC performance criteria to be supported for registration using some or all data from outside Ontario. This allowed producers to have access to these varieties 2 years earlier than

under the previous system. The OFCC still conducts performance testing and still provides performance data from public trials in Ontario to producers as in the past.

A significant change could occur over the next year as the CFIA has proposed that merit-based registration be eliminated for all forage crop species. Whether a requirement for some data on agronomic performance will be required is not clear at the time of writing. This could significantly affect the performance testing system since new varieties may no longer have a legal requirement to be tested in public Ontario tests. The OFCC has prepared a position paper to present to CFIA, which recommends that some agronomic data be available to producers at the time of registration. (Appendix I) The OFCC has essentially accepted that quality testing cannot be made financially viable through the committee structure and has decided to eliminate that option for the near term. At the same time, the OFCC has redesigned its fee structure in an attempt to secure enough funds to continue public testing while still extending the results of the testing to the end user. (Appendix II) The new fee system should eventually incorporate not only the seed trade, but also commodity groups and other interested parties. The OFCC recommends that variety testing for yield and persistence is continued.

13. Development of tobacco varieties, with broad based, high tolerance to pest and diseases using conventional approaches, and investigate the use of marker assisted selection quality - Ontario Tobacco Committee

The tobacco-breeding program has been very successful in developing varieties that meets the needs of the growers and the industry. Several high yielding, superior quality and pest resistant cultivars have been developed using conventional breeding methodologies. However, in recent years, molecular markers linked to traits of interest have been identified in a number of crop species. This has greatly enhanced the breeding programs of many crops. In tobacco very few molecular markers have yet been developed and no marker-based map is available. These are achieved through conventional hybridization, selection of desirable traits, and performance evaluation.

Recommendation 3

Market Responsiveness

Research strategies to address market development, new product development, food safety and enhancement.

Competing in traditional commodity markets will become more difficult for Ontario producers in the next several years. This will require increasing emphasis on the development of new higher-value markets for Ontario field crops with the integration of the producer up the value-chain. Research in these areas has been ongoing for several years, however, with the increasing emphasis on life sciences and food quality and safety, further targeted efforts are required. Most of this work will strive to take advantage of the history of IP crop production in Ontario and the existing and developing infrastructure to support these markets.

1. Development of specialty soybean types and alternative uses for soybean – Ontario Oil and Protein Seed Crop Committee.

Issue: Increasing opportunities for adding value to soybean

Oil modifications:
Food Use -modify oil to improve healthfulness, and increase oil functionality
Industrial Use -modify oil to increase functionality

Protein/Carbohydrate Modifications:
Food Use -modifications to improve quality of soyfoods, capture premium soyfood markets
Feed Use -increase the content of soybean protein or essential amino acids to increase value of soybean meal as a feed supplement remove or reduce anti-nutritional factors.

Background: Soybean oil and protein are used in the manufacture of human food, animal feed, and various industrial products. Soybean oil dominates the domestic and world vegetable oil markets. The oil contains saturated [palmitic (11%), stearic (4%)], monounsaturated [oleic (25%)], and polyunsaturated [linoleic (50%), linolenic (9%)] fatty acids. Because of its fatty acid profile, the oil is used primarily as a salad and cooking oil and as a fat in the production of shortening and margarine. Only 2% of all soybean oil produced is used in industry. Specific genetic modifications can be made to improve oil content, quality and stability. These modifications can educe processing costs and increase the marketability and value ($.08 to $3 US /bushel) of soybeans (Iowa Agriculture & Home Economics Experiment Station Special Report 92)

Soybean protein constitutes about 46% of soybean meal and is used as an ingredient in animal feed, human food, and industrial products. About 95% of soybean meal is used to supply protein in livestock (poultry, swine, cattle) feeds. For use in food and products and industrial products, soybean meal is processed into various edible protein ingredients, including flour, concentrates, isolates. Most edible protein products are used to replace the use of animal and dairy proteins in foods for human consumption. Industry uses soybean protein primarily in the manufacture of paper coatings. Improving the content and quality of soybean protein can add $.06 to $.46 (US) to each bushel of soybean (Iowa Agriculture & Home Economics Experiment Station Special Report 92) and increase the nutrition, energy density, and marketability of soybean meal. Soybean produced in Ontario must compete in the international marketplace with soybean and other oilseeds produced throughout the world. To maintain a share of the specialty oilseed market, each Ontario soybean variety must possess traits that provide added value and a unique identity. Using current technologies (chemical mutagenesis, biotechnology, and breeding) oil and protein modifications can be made to add value and improve the marketability of soybean varieties developed in Ontario.

Detailed modifications include

A. ***Oil Modifications***:

1. Food Use

a) Increase palmitic and/or stearic acids (16-18%) to improve crystalline structure and use in solid fat applications

b) Reduce level of saturated fats (<6%) to reduce negative health effects

c) Increase oleic (while lowering saturated and/or polyunsaturated fats) to increase oxidate stability

2. Industrial Use

a) Increase linolenic acid (>55%) to replace linseed oil as a drying oil in the manufacture of paints and coatings

b) Add exotic fatty acids [recinoleic (>85%) and lauric acid (>50%)] to soybean to increase use in the manufacture of lubricating oil and other industrial products

B. ***Protein/Carbohydrate Modifications*:**

1. Food Use

a) Reduce content of fermentable carbohydrates to reduce intestinal discomfort and flatulence

b) Increase content of fermentable carbohydrates (sucrose, glucose, fructose) and increase the use of soybeans in the manufacture of soyfoods (miso, natto, tempeh)

c) Reduce lipoxygenase enzymes to reduce the beany or off-flavour

c) Reduce phenolics and flavonoids to reduce astringency and bitterness

2. Feed Use

a. Increase the content of soybean protein to increase value of soybean meal as a high protein feed Supplement

b) Increase content of essential amino acids (methionine and cysteine)

c) Increase lysine content to reduce the concentration of crude protein in the diets of poultry and swine

d) Reduce protease inhibitor activity by 80% to improve the digestion of proteins and reduce pancreatic hypertrophy

e) Reduce phytate to improve the availabilty of minerals protein solubility

f) Reduce goitrogens to reduce the risk of goiter

2. Develop Value Added Markets for Corn – Ontario Corn Committee

Food grade quality corn represents a major value-added market for Ontario corn that has the potential to expand significantly. Currently, much of the market is being filled with corn or corn products from the U.S.A. Development of food grade quality corn suitable for production in Ontario represents a significant import-replacement opportunity, as well as an important export market.

Research has begun within the University of Guelph, primarily at Ridgetown College, directed toward breeding early white, food grade corn inbreds and hybrids, suitable for production in Ontario and toward identifying yellow corn hybrids of food grade quality, in co-operation with the private sector.

Long-term funding is required to enhance the technical support for these programs and to ensure the continuation of this work.

3. New Markets – Ontario Cereal Crops Committee

Background: Development of new markets is a way to expand acreage and value of the crops grown. When successful, efforts of this nature often have great benefit. Milling oat and malting barley are two areas that are currently underway within the sector. This has the potential to expand production by up to 100,000 acres, into a premium market. Other opportunities exist that should be investigated.

Economic importance: Premiums for this type of market often run from $10 to $40 per tonne to the producer, and can develop whole new processing opportunities. Care must be taken, however, to discern actual acreage that could be affected by these developments. Development of high value biotech components that require very small acreage, while beneficial, have far less overall economic impact to the sector.

4. Edible Bean quality evaluation and utilization – Ontario Pulse Committee

Details Customers of edible beans are placing more value on quality traits. The industry needs to examine the composition of edible beans for traits of special value for food, neutraceuticals, or industrial uses. Examples would include screening for components such as Biofavonoids, Saponins, oliosaccharides. Ontario is well positioned to grow premium priced speciality bean types. Industry has invested significantly in infrastructure and other resources to meet ISO standards for the export market.

Background Static yields and economies of production have placed white beans in Ontario at a competitive disadvantage to Manitoba and recent entrances to this market. Ontario has maintained market share of large seeded coloured bean types due to demand for diverse market types, reputation for quality, and industry infrastructure for identity preserved production and marketing. The industry sees a need to shift the focus from producing a commodity to a 'market or buyer' driven bean that have unique or novel output traits. The value of such traits must return incremental margins to all sectors of the industry. The special quality characteristics for food and industrial use are largely unknown. It is recognized that edible beans contain some unique starch, protein and fibre characteristics. Health professionals have recognized the value of edible beans for their health benefits. However only a few researchers have studied pulse utilisation for food and industrial uses. Little is known of the compositional traits that may be of special value.

Current Research/Extension Activities
Work at AAFC, Harrow and University of Guelph has focused on developing, and evaluating germplasm and varieties for canning quality. Efforts have also been directed to factors that have an influence on flatulence, and altered sugar content and quality. Ongoing research is working on expanding the germplasm base.

Gaps/Barriers/Deficiencies

Funding is required to conduct a literature review of research on quality components, complete compositional analysis, and investigate traits that may have special value. Research also needs to address standard methodologies in conducting analysis. In addition the industry needs to keep abreast of research into the health benefits of edible beans and new and expanded uses for food, neutraceuticals, and industrial use.

Research Recommendation High priority, little research underway, new funding requested.

5. Development of Alternative Pulse types for Ontario – Ontario Pulse Committee

Issue Development of alternative pulses, specialty market types.

Details AAFC, Harrow is currently conducting research into cultivar development and agronomic practices for pigeonpeas, mungbeans, kintoki, and adzuki for Ontario. Further research is required to investigate agronomic practices and develop and test cultivars.

Background There is a small but growing demand domestically and for export of speciality bean types. Ontario for example imports over 5 million lbs. of mungbeans, mainly for sprouts, each year. Mungbean yields in Ontario trials have averaged 1000-1300 lbs./ac. The market price in Ont. Is 40-50 cents/lb. on average, and as high as 70-80 cents at times. One variety has been developed AC Harowsprout, and is being multiplied by select seed growers. Mungbeans are adapted to areas with 2900 hu or more while pigeonpeas are longer season, adapted to areas receiving 3200 hu or greater. Kintoki, Otebo, and adzuki beans are being grown on a limited but growing number of acres for export to Japan.

Research Recommendation Important, continue research at existing level

6. Forage Grading System – Ontario Forage Crops Committee

The importance of a well-defined grading system in the buying and selling of agricultural commodities is undisputed. In contrast, no uniform grading system for legume, grass or mixed hays exists in Canada nor in the U.S. Hay purchasers located in areas with no consistent hay grading system must evaluate each hay lot purchased. They can apply the hay grading system of their choice, sample hay and run chemical analyses to evaluate hay quality, or visually inspect hay and make an informed opinion of the hay. The best method involves combining visual judging with chemical analyses. With many components to evaluate the problem becomes one of simplifying the values to establish a grade that satisfies both seller and buyer.

The problem is particularly acute in Ontario where hay may be shipped long distances. Markets exist not only in the southern U.S., but also overseas. The OFCC regards this issue as an important one that requires a system paralleling the benefits of other commodity grading systems such as corn or wheat. The OFCC defines this issue as one of pulling existing information

together and arriving at a consensus rather than one that requires an expansion of research efforts.

7. Improvement to Grading System – Ontario Cereal Crops Committee

Background: Grain grading has tremendous impact through the industry. Grain downgraded reduces the price paid to the producer, may restrict export options, and grain that is not graded properly due to factors like fusarium can become unusable by millers once actual vomitoxin levels are known.

Despite the importance of grain grading to the industry, it has remained a subjective test, relying on visual inspection for colour and other parameters. With the vagaries of human eyesight, this has led to many inconsistencies within the grading system. This was proven by a study undertaken in 2000 by Dr. Art Schaafsma.

Development of an objective grain grading system is essential to ensure proper streaming and returns of grain produced and processed across the industry.

Economic importance: Grain graded as feed that is actually of milling quality reduces the price paid to the producer by $15/tonne. Grain that is accepted as milling quality, which is subsequently found to be above acceptable limits for vomitoxin, is of no value to the miller and must be removed from the system at significant cost.

Competitiveness: A consistent and accurate grain grading system would ensure that buyers of Canadian grain abroad would receive the quality of product that they expected. This would further enhance the Canadian reputation for quality, and premiums attached. This grading system would also ensure that both producers and end users in the province are treated fairly.

8. Environmental Impact of Genetically modified Crop production – Ontario Oil and Protein Seed Crop Committee

Issue: To evaluate and monitor the ecological and environmental impact of corn hybrids, soybean varieties and other crops as required with special traits derived through biotechnology.

9. Improving crop quality - Ontario Tobacco Committee

1- Effect of different nitrogen rates, topping height and varieties on tobacco yield and quality.

Results from a survey conducted at the farm level in the flue-cured tobacco growing areas of Ontario over a three-year period (1998-2000), indicate a wide variation in cured leaf chemistries. Available nitrogen was identified as being an influential factor in cured leaf chemistries. Because of the survey results, there is now a need to identify the effects of different nitrogen rates and topping heights, which are also known to affect cured leaf chemistries, on certain varieties of flue-cured tobacco grown in Ontario.

2- Identify the cause (s) and solution (s) to tobacco bruising.

A survey examining the incidence and potential causes of bruise green grades was conducted in 1994. Most growers felt that it was caused by dry conditions, lack of nitrogen and choice of cultivar, or an interaction between those factors. Bruise green grades are now being monitored in the breeding program so that genotypes prone to bruising can be selected out before commercialization. No work has yet been undertaken that addresses the climatic or agronomic conditions that may influence this condition.

3- Optimize cured leaf quality by evaluating direct measurement of weight loss as a curing control technique.

Curing tobacco requires control of temperature and humidity plus the knowledge of how, when and at what rate to apply heat and ventilation to produce optimum leaf quality. Curing is the single most important post harvest factor influencing leaf quality, yet the curing process is poorly understood.

4- Further develop measures to reduce TSNA's in cured tobacco.

Nitrosamines are chemical compounds considered to be carcinogenic (cancer-causing) Nitrosamines have been the focus of research for many years. In Ontario, prior to 2000, almost all-curing systems to cure flue-cured tobacco were equipped with a direct-fired heating system. In the year 2000 indirect-fired heating systems were introduced. Research conducted at Delhi comparing direct-fired to indirect-fired indicates that heat indirect-fired reduced TSNA in the cured leaf by about 94%. Further studies are needed to develop measures to reduce TSNA in cured tobacco.

Service Priorities

Service priority 1: Extension and information validation

Background: As new technologies become available, information about these technologies must be disseminated throughout the sector. These technologies must also be assessed for wide area adaptability, or specific geography or situations were they perform to the benefit of the user. Without this extension and validation of new technologies, advancements may never be accepted by the industry, or uptake may be slowed dramatically.

While extension efforts are often assumed to be intrinsic within the development of new technologies, this is rarely the case. Many research personnel are simply too busy to make this occur, or lack the network to promote the technology effectively. It is essential that this extension link exist, both to speed uptake and to make the research community aware of new and emerging problems and opportunities.

Economic importance: promoting uptake of the best new innovations ensures rapid acceptance and adoption of these technologies. This ensures that the full value of new enhancements is

realized. Extension services are considered "GATT green", indicating that all countries accept the tremendous value that extension efforts have.

APPENDIX I (a)

ONTARIO CEREAL CROPS COMMITTEE - MAIN

Organization	*Representative*
OMAFRA	Mr. P. Johnson, Chair
Ridgetown College	Dr. A.E. Smid, Secretary-Treasurer, exofficio
OCCC Production Subcommittee	Dr. G. Hoekstra
Public Plant Breeders	Dr. D.E. Falk
O.W.P.M.B.	Mr. P. Tuinema (C. Sherk, alt.)
OCCC Variety Subcommittee	Mr. A.R. McElroy
C.S.T.A.	Ms. G. Harris (J. Reid, alt.)
O.S.G.A.	Mr. P. Szentimrey (L. Trepanier, alt.)
Commercial Plant Breeders	Mr. L. P. Shugar (T. Welbanks, alt.)
O.S.C.I.A.	Mr. G. Beaudry (S. Ryzebol, alt.)

APPENDIX I (b)

ONTARIO CEREAL CROPS COMMITTEE SUBCOMMITTEE – VARIETY

C.P.B., C.S.T.A.	Mr. A.R. McElroy, Chairman
University of Guelph, O.A.C.	Mr. J. Rowsell, Secretary
Millers' Rep.	Mr. G. R. Carson
K.E.F.	Mr. L. Guillemette
E.C.O.R.C.	Dr. K. M. Ho
Kemptville College	Dr.G. J. Hoekstra
University of Guelph, O.A.C.	Dr. L. A. Hunt
Crop Technology, OMAFRA	Mr. P. Johnson
Crop Technology, OMAFRA	Mr. S. Banks
C.G.C.	Mr. J. Lowe
C.S.G.A.	Mr. M. Mackinnon
University of Guelph, O.A.C.	Dr. D.E. Falk
E.C.O.R.C.	Dr. R. S. Pandeya
Quality Co-ordinator	Dr. L. Pietrzak
O.W.P.M.B.	Mr. P. Tuinema (C. Sherk, alt.)
N.L.A.R.S.	Mr. J. Rowsell
Disease Co-ordinator	Dr. A. Xue
Ridgetown College	Dr. A. E. Smid
C.S.T.A.	Ms. G. Harris (J. Reid, alt.)
O.P.C.R.S.C., O.C.P.C.	To be Appointed
O.S.G.A.	Mr. P. Szentrimrey (L. Trepanier, alt.)
University of Guelph, O.A.C.	Mr. R. A. Upfold

C.P.B., C.S.T.A.	➢ Mr. L.P. Shugar (T. Wellbanks, alt.)
O.S.C.I.A.	➢ Mr. G. Beaudry (Mr. S. Ryzebol, alt.)
Thunder Bay Research Station, OMAFRA	➢ Mr. G. Scheifele
E.C.O.R.C.	➢ Dr. H. Voldeng

APPENDIX I (c)
ONTARIO CEREAL CROPS COMMITTEE - QUALITY, OF THE SUBCOMMITTEE VARIETY

P.R.C.	➢ Dr. L. Pietrzak, Chair
Robin Hood Multifoods	➢ Mr. G. R. Carson
Quaker Oats Co. Ltd.	➢ Mr. M. Morrison
Corporate Foods	➢ Mr. N. Woodbeck
C.G.C.	➢ Mr. J. Lowe
Reid Milling	➢ Mr. M. Mak
O.W.P.M.B.	➢ Mr. P. Tuinema (C. Sherk, alt.)
A.D.M.	➢ Mr. M. Neale
Hayhoe Flour Mills	➢ Mr. M. Hayhoe

APPENDIX I (d)
ONTARIO CEREAL CROPS COMMITTEE SUBCOMMITTEE - PRODUCTION

Kemptville College	➢ Mr. G. J. Hoekstra, Chair
O.M.A.F.R.A.	➢ Mr. S. Banks, Secretary
North West Ontario	➢ Mr. G. Scheifele
C.S.G.A.	➢ Mr. M. MacKinnon
University of Guelph, O.A.C.	➢ Dr. L. A. Hunt
University of Guelph, O.A.C.	➢ Dr. D. Falk
Ag & Rural Division, O.M.A.F.R.A.	➢ Mr. P. Johnson
K.E.F.	➢ Mr. L. Guillemette
E.C.O.R.C.	➢ Dr. A. R. McElroy
E.C.O.R.C.	➢ Dr. T.M. Choo
E.C.O.R.C.	➢ Dr. R. Pandeya
O.W.P.M.B.	➢ Mr. P. Tuinema (C. Sherk, alt.)
N.L.A.R.S. (O.S.M.R.S.C.)	➢ Mr. J. Rowsell
C.S.T.A.	➢ Ms. G. Harris (J. Reid, alt.)
E.C.O.R.C.	➢ Dr. A. Xue
E.C.O.R.C.	➢ Dr. H. Voldeng
Ridgetown College	➢ Dr. A. E. Smid
O.S.G.A.	➢ Mr. P. Szentimrey (L. Trepanier, alt.)

University of Guelph, O.A.C.	➢ Mr. R. A. Upfold
C.P.B., C.S.T.A.	➢ Mr. L.P. Shugar (T. Wellbanks, alt.)
O.S.C.I.A.	➢ Mr. G. Beaudry (Mr. S. Ryzebol, alt.)
C & M Seeds	➢ Ms. E. Sparry
W.G. Thompson & Sons Limited	➢ Mr. M. Etienne
O.P.C.R.S.C., O.C.P.C.	➢ To be appointed

ONTARIO CORN COMMITTEE
March, 2002

NAME	AFFILIATION	ADDRESS	TELEPHONE	FAX	E-MAIL
Mr. Greg Stewart	OMAF (Chair)	c/o Plant Ag Dept U of G, Guelph, ON, N1G 3W1	(519) 824-4120 Ext. 54865	519-763-8933	greg.stewart@omaf.gov.on.ca
Mr. David Morris	OCC, Secretary	Box 104, 10 Cambrai Rd, Markdale, ON, N0C 1H0	519-986-2385	519-986-2385	dtmorris@bmts.com
Mr. Larry Cowan	OCPA	RR#1, 7882 Longwoods Rd Mt Brydges, N0L 1W0	519-289-2106	519-289-5659	lcowan@wwdc.com
Mr. Ken Hough	OCPA (Alt)	90 Woodlawn Rd W, Guelph, ON, N1H 1B2	519-837-1660	519-837-1674	khough@ontariocorn.org
Mr. Paul Vogel	OSCIA	RR#2, 995 Lafleur Rd Apple Hill, On, K0C 1B0	613-528-4045	613-528-1048	vogelseeds@on.aibn.com
Mr. Keith Black	OSCIA (alt.)	RR#1, Belgrave, ON , N0G 1E0	519-357-1092 Cell: 519-357-7721	519-357-4955	kkblack@wightman.ca
Dr. Lana Reid	Agric & Agri-Food Can	ECORC, Bldg 99, Central Experimental Farm OTTAWA, ON, 1A 0C6	613-759-1619	613-952-9295	reidl@em.agr.ca
Dr. Liz Lee	U of G	Plant Ag Dept, Crop Sci Bldg U of G, N1G 2W1	519-924-4120 X53360	519-763-8933	lizlee@uoguelph.ca
Ms. Mary Lynn Lister	Seed Corn Growers of Ontario	825 Park Avenue W, Chatham, ON, N7M 5J6	519-352-6710	519-352-0526	oscgmb@xstaxcess.com
Mr. David Baute	Maizex Inc., (CPBA)	RR #2 Tilbory On, N0P 2L0	519-682-1720	519-682-2144	maizex@netrover.com
Henry Olechowski	Hyland Seeds (CPBA alt.)	2 Hyland Drive, Blenheim, On N0P 1A0	519-676-8146	519-676-5674	Holechowski@hylandseeds.com
Mr. David Scott	Pioneer Hi-Bred Ltd (CSTA)	Box 730 #2 Hwy W Chatham, On, N7M 5L1	519-352-6350	519-436-6753	dave.scott@pioneer.com
Mr. Jim Simon	Pride Seeds, (CSTA Alt.)	PO Box 1088, Chatham, On, N7M 5L6	519-354-3210	519-354-8155	jsimon@prideseed.com
Dr. Arend Smid	Ridgetown College	Ridgetown, On, N0P 2C0	519-674-1633	519-674-1600	asmid@ridgetownc.uoguelph.ca
Mr. Randy Ross (Treasurer)	Ridgetown College	Box 1258, Ridgetown, On N0P 2C0	W-519-674-1644 H-519-674-3932	519-674-1600	rross@xstaxcess.com
Mr. Scott Jay	Ridgetown College	Ridgetown, ON, N0P 2C0	519-674-1608	519-674-1600	SJAY@ridgetownc.uoguelph.ca
Bruce Humphries	Huron Res Stn	RR #1 Exeter, ON N0M 1S4	519-235-4075	519-235-3164	bhumphri@ridgetownc.uoguelph.ca
Mr. Byron Good	Crop Sci Bldg	U of G, GUELPH, ON, N1G 2W1	519-824-4120 Ex 58572	519-763-8933	bgood@uoguelph.ca
Ms. Cheryl Wightman	Kemptville College	Kemptville, On, K0G 1J0	613-258-8336 Ext 681	613-258-8410	cwightma@kemptville.uoguelph.ca
Mr. George McDiarmid	ECORC Bldg 99 Agric & Argi-Food Can	Ottawa, On, K1A 0C6	613-759-1546	613-992-9295	mcdiarmidg@em.agr.ca

Ontario Oil and Protein Seed Crop Committee

COMMITTEE MEMBERS

Group Identifiers:
VSC - Variety Subcommittee members
ROC - Rest of Committee (additional main committee members)
CSS - Canadian Seed Sponsors
CSC - Canola Seed Committee
CANO - Canadian Organisations
USAO - USA Organizations

VSC

Name	Tel	Fax	E-mail
Dr. Gary Ablett	519 674-1505 ,cell: 519-355-8551 .	519 674-1515	gablett@ridgetownc.uoguelph.ca
Dr. Terry Anderson	519-738-2251, x 426	519-738-2929	andersont@em.agr.ca
Mr. James Beer	519-848-3438	519-848-3857	
Mr. Dan Brown	519-844-2426	519-844-2424	63575@mnsi.net
Dr. Dick Buzzell	519-738-2251, x 470	519-738-2929	buzzelld@wincom.net
Dr. Elroy Cober	613-759-1610	613-759-6597	coberer@em.agr.ca
Mr. Neil Driscoll	519-638-3252	519-638-5420	
Ms. Louise Duke	613-225-2342 x4387	613-228-6629	lduke@ncrh.em.agr.ca
Mr. Chris Gillard	519-674-1632	519-674-1600	cgillard@ridgetownc.uoguelph.ca
Mr. Ron Guillemette	613-759-1611	613-759-6597	guillemettr@em.agr.ca
Ms. Gail Harris	613-225-6891	613-225-6422	seed@secan.com
Mr Bob Hart	519-537-5157; 888-537-5157	519-537-5169	proseeds@oxford.net
Mr. Alejandro Hernandez	519-821-0781	519-821-7522	ahernandez@soybeans.com
Dr. Dave Hume	519-826-3800	519-826-3841	dhume@research.uoguelph.ca
Dr. Howard Love	705-324-3293	705-324-2550	hlove@swseed.ca
Mr. John Madill	613-258-8347	613-258-8384	jemadill@magi.com

Mr. Brad Martin	519-343-3035	519-343-4589	bradm@wcl.on.ca
Mr. Don McClure	519-461-0072, ext 232	519-461-0770	don.mcclure@syngenta.com
Mr. Jim Olmsted	519-676-8146	519-676-5674	JOlmsted@wgthompson.com
Mr. Rene Petroski	519-352-7730	519-352-8983	petroskir@soybean.on.ca
Dr. Vaino Poysa	519-738-2251 x 467	519-738-2929	poysav@em.agr.ca
Dr. Istvan Rajcan	519-824-4120 x 3564	519-763-8933	irajcan@plant.uoguelph.ca
Mr. Rob Templeman	519-345-0169; cell 276-9818	519-345-0169	rob.templeman@pioneer.com
Mr. Albert Tenuta	519 674-1617	519 674-1564	atenuta@omafra.gov.on.ca
Dr. Pierre Turcotte	450-653-4413, ext 228	450-441-5694	pierre.turcotte@agr.gouv.qc.ca
Mr. John Van Herk, Jr	519-676-8146	519-676-5674	jvanherk@wgthompson.com
Mr. Tom Welacky	519-738-2251 x 469	519-738-2929	welackyt@em.agr.ca
Mr. Tim Welbanks	519-352-6350	519-436-6753	tim.welbanks@pioneer.com
Mr. Bill Zubrinic	905-527-9121	905-527-3162	

CSS

Name	Tel	Fax	E-mail
Dr. Gary Ablett	519 674-1505 cell: 519-355-8551	519 674-1515	gablett@ridgetownc.uoguelph.ca
Mr. Christian Azar	450-799-2326	450-799-2328	azarc@co-op.ca
Mr. Dave Baute	519-682-1720	519-682-2144	maizex@netrover.com
Mr. Arthur Bolton	519-527-0455	519-527-0787	
Mr. Peter Bonis	705-324-0544	705-324-2550	sloffice@seed-link.ca
Mr. Norm Bradner	519-352-4178		abradner@netrover.com
Mr. Dan Brown	519-844-2426	519-844-2424	63575@mnsi.net
Ms. Helene Chretien	450-469-5744	450-469-4547	helene.chretien@prograin.qc.ca
Dr. Elroy Cober	613-759-1610	613-759-6597	coberer@em.agr.ca
Mr. Peter Craig	705-324-6273	705-324-1803	pcraig@pickseed.com
Mr. Grant Craven	519-354-3210 x 213	519-354-8155	kingagro@ciaccess.com
Mr. Stuart Cullen	888-537-5157	519-537-5169	proseeds@oxford.net
Mr. Eric Denotter	519-798-3839 x 249	519-798-3222	eric@lacoop.com
Ms. Julie Durand	819-362-8823	819-362-3385	semilabo@ivic.qc.ca
Mr. Marc Eberle	519-351-5101	519-354-8603	meberle@odyssey.on.ca
Mr. Donald Ferguson	519-776-5779	519-776-9319	
Mr. John Gibson	905-814-4266	905-814-4383	jgibson@growmark.com
Mr. Thierry Gripon			
Mr. Ron Guillemette	613-759-1611	613-759-6597	guillemettr@em.agr.ca
Ms. Gail Harris	613-225-6891	613-225-6422	seed@secan.com
Mr. Bob Hart	519-537-5157; 888-537-5157	519-537-5169	proseeds@oxford.net
Dr. Brad Hedges	519-352-2700, x 6720 mobile 358-5806	519-380-2008	bradley.hedges@pioneer.com
Mr. Alejandro Hernandez	519-821-0781	519-821-7522	ahernandez@soybeans.com
Mr. Chris Hildreth	519-268-8001	519-268-8013	childreth@uap.ca
Mr. Ron Kowalski	705-324-9591	705-324-0882	rsi@lindsaycomp.on.ca
Mr. Roger Latour			rlatour@agrocentrebelcan.com
Mr. Rejean Laquerre		418-339-2474	
Ms. Delores Leader		519-351-6671	
Mr. Brian Legassicke brian.c.legassicke@monsanto.com	519-740-1759	519-740-1759	
Mr. Patrice Levesque	519-685-5152	519-681-4557	pglevesque@dowagro.com
Mr. Sandy Liddle	519-528-2092	519-528-3542	soybean@hurontel.on.ca
Mr. Ron Lloyd	705-424-1410	705-424-3837	maplefar@bconex.net
Dr. Howard Love	705-324-3293	705-324-2550	hlove@swseed.ca
Mr. Reinhdt von Martels	519-674-0054	519-674-0388	vonmartels@on.aibn.com
Mr. Don McClure	519-461-0072, ext 232	519-461-0770	don.mcclure@syngenta.com
Mr. Henry Mergl	519-737-6851	519-737-9601	
Mr. Larry Miehls	519-723-4476	519-723-2146	miehls99@mnsi.net
Mr. Larry Morris	519-262-3002, ext 321	519-262-2317	lmorris@hdc.on.ca
Mr. Jim Olmsted	519-676-8146	519-676-5674	JOlmsted@wgthompson.com
Mr. Dale Petrie	519-352-4443	519-352-9559	dale@directseeds.com
Mr. Rene Petroski	519-352-7730	519-352-8983	petroskir@soybean.on.ca
Dr. Vaino Poysa	519-738-2251 x 467	519-738-2929	poysav@em.agr.ca

CSS Cont'd....

Name	Tel	Fax	E-mail
Dr. Istvan Rajcan	519-824-4120 x 3564	519-763-8933	irajcan@plant.uoguelph.ca
Mr. William Reymer	519-764-4220	519-765-4220	
Mr. Dave Salenbien	519-627-2681	519-351-2516	
Mr. Ross Simpson	519-354-3210, ext 285	519-354-9390	rsimpson@soygenetics.com
Mr. Fred Sinclair	519-354-3210 ext 274	519-354-8155	fsinclair@prideseed.com
Ms. Ellen Sparry	519-343-2126	519-343-3792	esparry@redwheat.com
Mr. David Stanley		519-537-5169	proseeds@oxford.net
Mr. Albert Tenuta	519 674-1617	519 674-1564	atenuta@omafra.gov.on.ca
Ms. Cecile Tetreault	450-799-3225	450-799-3229	nlanoie@semico.ca
Mr. Robert Thom	905-729-2202	905-729-2623	parseed@bconnex.net
Mr. Gilles Tremblay	450-653-4413	450-441-5694	
Dr. Pierre Turcotte	450-653-4413, ext 228	450-441-5694	pierre.turcotte@agr.gouv.qc.ca
Mr. Bill van der Vlist	519-627-1491	519-627-2990	billvan@mnsi.net
Mr. John Van Herk, Jr	519-676-8146	519-676-5674	jvanherk@wgthompson.com
Mr. Bryan Van Oostveen	519-349-2600	519-349-2688	BWVan-oostveen@dowagro.com
Mr. Roy van Wyk	519-528-2431	519-528-3518	advantag@hurontel.on.ca
Mr. Marty Vermey	519-352-4316	519-352-5983	marty.vermey@na2.monsanto.com
Dr. Harvey Voldeng	613-995-3700	613-759-1701	voldeng@em.agr.ca
Mr. Bill Webster	800-265-5289	519-681-4557	
Mr. Jamie Williamson	519-528-2431	519-528-3518	advantage@scsinternet.com

CSC

Name	Tel	Fax	E-mail
Mr. Allan Eadie	519-622-0410 Ext 235	519-622-9184	
Dr. Dave Hume	519-826-3800	519-826-3841	dhume@research.uoguelph.ca
Dr. Howard Love	705-324-3293	705-324-2550	hlove@swseed.ca
Mr. Brad Martin	519-343-3035	519-343-4589	bradm@wcl.on.ca
Mr. Chris Meier	888-768-4395	705-324-0882	rsi@lindsaycomp.on.ca
Mr. Joe Omielan			jomielan@uoguelph.ca
Mr. Jim Olmsted	519-676-8146	519-676-5674	JOlmsted@wgthompson.com
Dr. Ottmar Philipp	204-822-4956	204-822-4958	
Ms. Linda Piper	519-291-4811	519-291-5111	
Mr. Robert Thom	905-729-2202	905-729-2623	parseed@bconnex.net
Mr. John Van Herk, Jr.	519-676-8146	519-676-5674	jvanherk@wgthompson.com

ROC

Name	Tel	Fax	E-mail
Mr. John W. Clarke	519-436-3190	519-436-3195	jclarke@cgc.ca
Mr. David Forster	416-761-4175	416-761-4452	dave.forster@sympatico.ca
Dr. Mark Gijzen	519-663-3552	519-663-3454	gijzenm@em.agr.ca

Dr. Stephen Molnar	613-759-1687	613-759-1701	molnarsj@em.agr.ca
Mr. John Rowsell	705-647-6701	705-647-7008	
Dr. Harvey Voldeng	613-995-3700	613-759-1701	voldeng@em.agr.ca
Dr. Kangfu Yu	519-738-2251, ext 479	519-738-2929	yuk@em.agr.ca

CANO

Name	Tel	Fax	E-mail
Dr. Steve Bowley	519-824-4120 ext. 8704	519-763-8933	sbowley@crop.uoguelph.ca
Mr. Dick Speare	Tel-519-338-3840	Fax-519-338-2510	
Dr. Pierre Turcotte	450-653-4413, ext 228	450-441-5694	pierre.turcotte@agr.gouv.qc.ca

USAO

Name	Tel	Fax	E-mail
C. R. Carr (Ande)	800-233-3379		
	Mobile 419-351-6861	419-822-3312	
	Res: 419-893-3603	Res: 419-822-5444	
Mr. Jeff Griffeth	219-567-9141	219-567-2645	
Mr. Mark Lawson	815-758-9326	815-758-4106	mlawson@dekalb.com
Mr. Brian Legassicke	519-740-1759	519-740-1759	
brian.c.legassicke@monsanto.com			
Mr. Mitch Ray	800-257-7333	517-725-8356	
Mr. Dennis Shultze			schultze@mycogen.com

ONTARIO PULSE COMMITTEE

Main Committee

NAME	REPRESENTATION	ADDRESS	PHONE/FAX/E-MAIL
Bob Roy, Treasurer 1998-2002	AAFC/SCPFRC-Delhi	Box 186, Delhi, Ont. N4B 2W9	(519) 582-1950/582-4223 royr@em.agr.ca
Chris Gillard, Secretary 1998-2002	Ridgetown College, U of Guelph	Ridgetown College Main St. E. Ridgetown, N0P 2C0	(519) 674-1632/674-1600 cgillard@ridgetownc.uoguelph.ca
Tino Breuer	OMPMB	4206 Raney Cres. London Ont. N6L 1C3	(519) 652-3566/652-9607 tbreuer@ontariobeans.on.ca
Brian Hall (chair)	OMAF	Stratford Resource Centre, 581 Huron St. Stratford, ON, N5A 5T8	(519) 271-0083/273-5278 brian.hall@omafra.gov.on.ca
Tom Smith	Plant Ag, U of Guelph	Plant Ag. Dep., Univ. Of Guelph, Guelph, ON N1G 2W1	(519)824-4120(ext8339)/763-8933 tsmith@uoguelph.ca
Soon Park	AAFC -Harrow	Harrow Research Centre Harrow, Ontario, N0R 1G0	(519) 735-2251/738-2929 parks@em.agr.ca
Tom Michaels	Plant Ag. U of Guelph	Plant Ag Dept. Univ of Guelph, Guelph, Ont N1G 2W1	(519) 824-4120 tmichaels@crop.uoguelph.ca
Grant Watson (observer)	CFIA	59 Camelot Drive, Nepean	gwatson@em.agr.ca
Jeff Ferguson	OBDA	R.R. # 6, St. Thomas, Ontario, N5P 3T1	(519) 631-3463/631-8843 colinferguson@sprint.ca
John Van Herk Jr.	CPBC CSTA	Hyland Seeds P.O. Box 130, Blenheim, Ontario, N0P 1A0	(519) 676-8146 676-5674 Jvanherk@wgthompson.com
Garnet Wright	OBPMB	4206 Raney Cres. London Ont. N6L 1C3	fax: 519-482-3940
Art Bolton	CSGA	R.R.#1, Dublin	(519) 527-0455 527-0787(fax)

Jeff Allan	OSGA	R.R.#1 Brucefield	(519) 233-9846 allan@toc.on.ca

NAME	REPRESENTATION	ADDRESS	PHONE/FAX/E-MAIL
Bob Fotheringham	OBPMB	4206 Raney Cres. London Ont. N6L 1C3	(519) 233-9196 rfother@tcc.on.ca
Bernadine Wolfe	OCBGA	R.R. # 5, Mitchell, Ont.	(519) 348-4141/348-8165 wbwolfe@orc.ca
Mike Donnelly	OCBGA	R.R. #4, Thamesford, Ont. N0M 2M0	519-461-1055 mdonvan@odyssey.on.ca
Mike Tu	AAFC	Harrow Research Centre Harrow, Ont. N0R 1G0	(519) 738-2251/738-2929 tum@em.agr.ca

Variety Sub-Committee

NAME	REPRESENTATION	ADDRESS	PHONE/FAX/E-MAIL
Bob Roy	AAFC/SCPFRC-Delhi	Box 186, Delhi, ON. N4B 2W9	(519) 582-1950/582-4223 royr@em.agr.ca
Chris Gillard, Chair	Ridgetown College, U of Guelph	Ridgetown College Main St. E. Ridgetown, N0P 2C0	(519) 674-1632/674-1600 cgillard @ridgetownc.uoguelph.ca
Tino Breuer	OBPMB	4206 Raney Cres. London Ont. N6L 1C3	(519) 652-3566 tbreuer@ontariobeans.on.ca
Tom Smith	Plant Ag, U of Guelph	Plant Agriculture Department, Univ. Of Guelph, Guelph, ON N1G 2W1	(519) 824-4120(ext8339) tsmith@uoguelph.ca
Tom Michaels	Plant Ag. U of Guelph	Plant Ag Dept. Univ of Guelph, Guelph, Ont N1G 2W1	(519) 824-4120 tmichaels@crop.uoguelph.ca
Brian Hall	OMAF	Stratford Resource Centre, 581 Huron St. Stratford, ON, N5A 5T8	(519) 271-0083/273-5278 brian.hall@omafra.gov.on.ca
Soon Park	AAFC -Harrow	Harrow Research Centre Harrow, Ont. N0R 1G0	(519) 735-2251/738-2929 parks@em.agr.ca
Garnet Wright	OBPMB	4206 Raney Cres. London Ont. N6L 1C3	fax: 519-482-3940

Grant Watson (observer)	CFIA	59 Camelot Drive, Nepean	gwatson@em.agr.ca
NAME	REPRESENTATION	ADDRESS	PHONE/FAX/E-MAIL
Allan Patterson (observer)	Patterson Grain		(519) 461-1829/461-0879
Bruce Cruikshank	OCBGA	R.R #2 Paris	grbean@bis.on.ca
Jeff Ferguson	OBDA	R.R. # 6, St Thomas, Ontario	(519) 631-3463/631-8843 colinferguson@sprint.ca
John Van Herk Jr.	CPBC CSTA	Hyland Seeds P.O. Box 130, Blenheim, Ontario, N0P 1A0	(519) 676-8146/ 676-5674 Jvanherk@wgthompson.com
Mike Donnelly	OCBGA	R.R. #4, Thamesford, Ont. N0M 2M0	519-461-1055 mdonvan@odyssey.on.ca
Bob Fotheringham	OWBP	4206 Raney Cres. London Ont. N6L 1C3	(519) 233-9196 rfother@tcc.on.ca
Art Bolton	CSGA	R.R.#1, Dublin	(519) 527-0455/527-0787
Jeff Allan (alt)	OSGA	R.R.#1 Brucefield	(519) 233-9846 allan@toc.on.ca
Les Coleman	OSGA	R.R. # 3, Kippen, Ont N0M 2E0	(519) 263-2990
Stuart Alyesworth (obs)	Gen-Tec Seeds		(519) 975-2557 gentec@on.aeba.com
John Alyesworth (obs)	Gen-Tec Seeds		(519) 975-2557
Mike Wood (obs)	Norvartis Seeds Inc. Nampa Idaho		(208) 465-8533 mike.wood@seeds.novartis.com
Diana Yanik (obs)	H.J. Heinz Co. Ltd	H.J. Heinz Co Ltd Erie St, South, Leamington, Ont. N8H 3W8	(519) 322-4024/322-4104

Research Planning and Assessment Sub-committee

NAME	REPRESENTATION	ADDRESS	PHONE/FAX/E-MAIL
Bob Roy Treasurer	AAFC/SCPFRC-Delhi	Box 186, Delhi, ON. N4B 2W9	(519) 582-1950/582-4223 royr@em.agr.ca
Chris Gillard, Secretary	Ridgetown College, U of Guelph	Ridgetown College Main St. E. Ridgetown,	(519) 674-1632/674-1600 cgillard @ridgetownc.uoguelph.ca

NAME	REPRESENTATION	ADDRESS	PHONE/FAX/E-MAIL
Brian Hall chair	OMAF	Stratford Resource Centre, 581 Huron St. Stratford, ON, N5A 5T8	(519) 271-0083/273-5278 brian.hail@omafra.gov.on.ca
Tino Breuer	OBPMB	4206 Raney Cres. London Ont. N6L 1C3	(519) 652-3566
Tom Smith	Plant Ag, U of Guelph	Plant Agriculture Department, Univ. Of Guelph, Guelph, ON N1G 2W1	(519) 824-4120(ext8339) tsmith@plant.uoguelph.ca
Tom Michaels	Plant Ag. U of Guelph	Plant Ag Dept. Univ of Guelph, Guelph, Ont N1G 2W1	(519) 824-4120 tmichaels@crop.uoguelph.ca
Soon Park	AAFC -Harrow	Harrow Research Centre Harrow, Ont. N0r 1G0	(519) 735-2251/738-2929 parks@em.agr.ca
Garnet Wright	OBPMB	4206 Raney Cres. London Ont. N6L 1C3	fax: 519-482-3940
Allan Patterson	Patterson Grain		(519) 461-1829/461-0879
Bruce Cruikshank	OCBGA	R.R.#2 Paris	grbean@bis.on.ca
Jeff Ferguson	OBDA	R.R. # 6, St Thomas, Ontario	(519) 631-3463/631-8843
John Van Herk Jr.	CPBC CSTA	Hyland Seeds P.O. Box 130, Blenheim, Ontario, N0P 1A0	(519) 676-8146/ 676-5674 Jvanherk@wgthompson.com
Bob Fotheringham	OWBP	4206 Raney Cres. London Ont. N6L 1C3	(519) 233-9196 rfother@tcc.on ca
Art Bolton	CSGA	R.R.#1, Dublin	(519) 527-0455/527-0787

Jeff Allan	OSGA	R.R.#1 Brucefield	(519) 233-9846 allan@toc.on.ca
Art Schaafsma	Ridgetown College, U. of Guelph	Ridgetown College Main St. E. Ridgetown, N0P 2C0	(519) 674-5456/674-3504
Peter Sikkema	Ridgetown College, U. of Guelph	Ridgetown College Main St. E. Ridgetown, N0P 2C0	

NAME	REPRESENTATION	ADDRESS	PHONE/FAX/E-MAIL
Lorna Woodrow	AAFC Harrow	Harrow Research Centre Harrow, Ont. N0R 1G0	(519) 738-2251
Kangfu Yu	AAFC Harrow	Harrow Research Centre Harrow, Ont. N0R 1G0	(519) 738-2251
John Madill	Kemptville College	Kemptville College U of Guelph Kemptville, Ont, K0G 1J0	(613) 258-8444/258-8384
Bob Hall	Environmental Biology U. Of Guelph	University of Guelph Guelph, Ont, N1G 2W1	(519) 824-4120/837-0442 rhall@evhort.uoguelph.ca

MEMBERS OF ONTARIO TOBACCO COMMITTEE AND ITS SUBCOMMITTEES FOR 2002

2002 Ontario Tobacco Committee (main committee)

H.M. Haji (Chair)
Canadian Tobacco Research Foundation
P.O. Box 1
Delhi, Ontario, N4B 2W8
Phone: (519) 582-2370, ext. 257
Fax: (519) 582-3678

Dan Van Hooren
Canadian Tobacco Research Foundation
P.O. Box 1
Delhi, Ontario, N4B 2W8
Phone: (519) 582-2370, ext. 271
Fax: (519) 582-3678

G. Amankwa
Canadian Tobacco Research Foundation
P.O. Box 1
Delhi, Ontario, N4B 2W8
Phone: (519) 582-2370, ext. 282
Fax: (519) 582-3678

Dan Ramer
Ontario Ministry of Agriculture,
Food
and Rural Affairs
P.O. Box 186
Delhi, Ontario, N4B 2W9
Phone: (519) 582-7220
Fax: (519) 582-4504

Denise Beaton
Ontario Ministry of Agriculture,
Food
and Rural Affairs
P.O. Box 186
Delhi, Ontario, N4B 2W9
Phone: (519) 582-7220
Fax: (519) 582-4504

Ron Brammall
Canadian Tobacco Research
Foundation
P.O. Box 1
Delhi, Ontario, N4B 2W8
Phone: (519) 582-2370, ext. 261
Fax: (519) 582-3678

2002 Membership of the Tobacco Production Practices Sub-Committee of OTC

Dr. Ron Brammall, **CHAIR** Tobacco Production Practices Sub-Committee of OTC Canadian Tobacco Research Foundation P.O. Box 1 711 Schafer Road Delhi, Ontario N4B 2W9 Phone: (519) 582-2370, Ext. 261 Fax: (519) 582-3678 Email: brammallr@on.aibn.com	Denise Beaton, **SECRETARY** Tobacco Production Practices Sub-Committee of OTC Ontario Ministry of Agriculture and Food P.O. Box 186 711 Schafer Road Delhi, Ontario N4B 2W9 Phone: (519) 582-7220, Ext. 263 Fax: (519) 582-4504 Email: denise.beaton@omaf.gov.on.ca
Dan Ramer, Tobacco Specialist Ontario Ministry of Agriculture and Food P.O. Box 186 711 Schafer Road Delhi, Ontario, N4B 2W9 Phone: (519) 582-7220, Ext. 264 Fax: (519) 582-4504 Email: dan.ramer@omaf.gov.on.ca	Bruce Abbey CropLife Institute c/o Bayer CropScience Canada 89 Normandy Gardens London, Ontario N6H 4B1 Phone: (519) 471-5128 Cell: (519) 878-6683 Fax: (519) 471-8111 Email: bruce.abbey@bayercropscience.com
Dan Van Hooren Canadian Tobacco Research Foundation P.O. Box 1 711 Schafer Road Delhi, Ontario N4B 2W9 Phone: (519) 582-2370, Ext. 271 Fax: (519) 582-3678 Email: dvanhooren@ontarioflue-cured.com	Dr. Godfried Amankwa Canadian Tobacco Research Foundation P.O. Box 1 711 Schafer Road Delhi, Ontario N4B 2W8 Phone: (519) 582-2370, Ext. 282 Fax: (519) 582-3678 Email: gamankwa@ontarioflue-cured.com
Dr. Hussein Haji Canadian Tobacco Research Foundation P.O. Box 1 711 Schafer Road Delhi, Ontario N4B 2W9 Phone: (519) 582-2370, Ext. 257 Fax: (519) 582-3678 Email: hhaji@ontarioflue-cured.com	Rick DeCoutere Imperial Tobacco Leaf Inc. P.O. Box 10, 516 John St. N. Aylmer, Ontario N5H 2R8 Phone: (519) 773-9251, Ext. 5218 Fax: (519) 765-2440 Email: rdecoute@itl.ca
Gaetan Duplessis Imperial Tobacco Leaf Inc. 3810, rue St-Antoine St. Montreal, Quebec H4C 1B5 Phone: (514) 932-6161, Ext. 2465 Fax: (514) 934-5928 Email: gdupless@itl.ca	Al Ratavicius Imperial Tobacco Leaf Inc. P.O. Box 10, 516 John St. N. Aylmer, Ontario N5H 2R8 Phone: (519) 773-9251, Ext. 5200 Fax: (5190 765-2440 Email: aratavic@itl.ca

Randy Corneillie JTI-Macdonald Inc. P.O. Box 310, No. 3 Highway West Tillsonburg, Ontario N4G 4H8 Phone: (519) 688-4125 Fax: (519) 688-0148 Cell: (519) 842-0073 Email: randy.corneillie@jt-int.com	Dave R. E. Thomas Rothmans, Benson & Hedges Inc. 174 Kennedy Road South Brampton, Ontario L6W 3G6 Phone: (905) 595-3009 Fax: (905) 595-0992 Email: dthomas@rbhinc.ca
Lori Long Rothmans, Benson & Hedges Inc. P.O. Box 101 Tillsonburg, Ontario N4G 4H5 Phone: (519) 842-6431 Fax: (519) 842-4313 Email: llong@rbhinc.ca	Steve Chapman Rothmans, Benson & Hedges Inc. 174 Kennedy Road South Brampton, Ontario L6W 3G6 Phone: (905) 595-3009 Fax: (905) 595-0992 Email: schapman@rbhinc.ca
Marcel Anseeuw Ontario Flue-Cured Tobacco Growers' Marketing Board P.O. Box 70 Tillsonburg, Ontario N4G 4H4 Phone: (519) 842-3661 Fax: (519) 842-7813 Email: cjacob@ontarioflue-cured.com	Alan DeGroote Ontario Flue-Cured Tobacco Growers' Marketing Board P.O. Box 70 Tillsonburg, Ontario N4G 4H4 Phone: (519) 842-3661 Fax: (519) 842-7813 Email: cjacob@ontarioflue-cured.com
Fred Neukamm Ontario Flue-Cured Tobacco Growers' Marketing Board P.O. Box 70 Tillsonburg, Ontario N4G 4H4 Phone: (519) 842-3661 Fax: (519) 842-7813 Email: cjacob@ontarioflue-cured.com	

2002 Ontario Flue-Cured Tobacco Variety Sub-committee

H.M. Haji, Chair
Canadian Tobacco Research Foundation
P.O. Box 1
Delhi, Ontario, N4B 2W8
Phone: (519) 582-2370, ext. 257
Fax: (519) 582-3678

Dan Van Hooren
Canadian Tobacco Research Foundation
P.O. Box 1
Delhi, Ontario, N4B 2W8
Phone: (519) 582-2370, ext. 271
Fax: (519) 582-3678

Denise Beaton
Ontario Ministry of Agriculture, Food and Rural Affairs
P.O. Box 186
Delhi, Ontario, N4B 2W9
Phone: (519) 582-7220
Fax: (519) 582-4504

3-As Designated
Ontario Flue-Cured Tobacco Growers' Marketing Board
P.O. Box 70
Tillsonburg, Ontario, N4G 4H4
Phone: (519) 842-3661
Fax: (519) 842-7813

1- As Designated Imperial Tobacco Ltd.
3810, rue St-Antoine St.
Montreal, Quebec, H4C 1B5
Phone: (514) 932-6161
Fax: (514) 934-5928

1-As Designated
RJR-Macdonald Inc.
2455 Ontario Street East
Montreal, Quebec, H2K 1W3
Phone: (514) 598-2525
Fax: (514) 598-0897

1-As Designated Rothmans, Benson & Hedges
64 Samor Road
North York, Ontario, M6A 1J7
Phone: (416) 789-7711
Fax: (416) 789-2386

2-As Designated
Tobacco Exporters Association
c/o Simcoe Leaf Tobacco
P.O. Box 280
Simcoe, Ontario, N3Y 4L1
Phone: (519) 426-22-1
Fax: (519) 426-0474

1-As Designated
Canadian Tobacco Seed Producers

Ontario Weed Committee membership

Organisation	NAME	ADDRESS
AAFC	Al Hamill	Greenhouse & Processing Crops Research Centre Harrow, ON, N0R 1G0
AAFC	Susan Weaver	Greenhouse & Processing Crops Research Centre Harrow, ON, N0R 1G0
AAFC	Stephen Darbyshire	Eastern Cereal & Oilseed Research Centre Ottawa, ON, K1A 0C6
AAFC	Diane Lyse Benoit	AAFC Horticultural R & D Centre Saint-Jean-sur-Richelieu, PQ, J3B 3E6
Health Canada	Ross Pettigrew	Pest Management Regulatory Agency Guelph, ON, N1G 4S9
University of Guelph	J. C. Hall	Dept. of Environmental Biology Guelph, ON, N1G 2W1
University of Guelph	John O'Sullivan	Dept. of Plant Agriculture Guelph, ON, N1G 2W1
University of Guelph	Clarence. J. Swanton	Dept. of Plant Agriculture Guelph, ON, N1G 2W1
University of Guelph	François Tardif, Chair	Dept. of Plant Agriculture Guelph, ON, N1G 2W1
University of Guelph	Wendy Asbil	Kemptville College Kemptville, ON, K0G 1J0
University of Guelph	Peter Sikkema	Ridgetown College Ridgetown, ON, N0P 2C0
University of Guelph	Darren Robinson	Ridgetown College Ridgetown, ON, N0P 2C0
University of Guelph	Steven B. Clegg	Laboratory Services Division Box 3650, 95 Stone Rd. W. Guelph, ON, N1H 8J7
OMAF	Jennifer Llewellyn	Nursery Crop Specialist University of Guelph Guelph, ON, N1G 2W1
OMAF	Leslie Huffman, secretary	Crop Technology c/o AAFC 2585 County Rd. 20 Harrow, ON, N0R 1G0
OMAF	Gilles Quesnel	Field Crop IPM Program Lead Kemptville, ON, K0G 1J0
OMAF	Mike Cowbrough	Weed Specialist (Field Crops) Dept. of Plant Agriculture Guelph, ON, N1G 2W1
OME	Geoff Cutten	40 St. Clair Ave. W., 7th Floor Toronto, ON, M4V 1M2
OME	Mark Chappel	40 St. Clair Ave. W., 7th Foor Toronto, ON, M4V 1M2
OMNR	Michael Irvine	Forest Management Branch Sault Ste Marie, ON, P6A 6V5
Ontario Pesticide Advisory	Doug Mewett	Executive Secretary

Committee		ON Ministry of Environment 135 St. Clair Ave. W., Suite 100 Toronto, ON, M4V 1P5
Ontario Pesticide Advisory Committee	Clayton M. Switzer	Chairman, OPAC 16 Tamarack Pl. Guelph, ON, N1E 3Y6
Ontario Pesticide Advisory Committee	Don Lobb	OPAC 1009 Boston Mills Rd. Terra Cotta, ON, L0P 1N0
Crop Life Canada	Luc Bourgeois	Bayer Inc. Eden Mills, ON, N0B 1P0
Crop Life Canada	Scott MacDonald	BASF Canada Guelph, ON, N1H 8C8
Member at Large	Patrick Lynch	Cargill Consulting Shakespeare, ON, N0B 2P0
Member at Large	Gabrielle Ferguson	Global Agricultural Business Enterprises Alvinston, ON, N0N 1A0
Certified Crop Advisor	Craig Chapple	W.G. Thompson & Sons Ltd. Blenheim, ON, N0P 1A0
Innovative Farmers Association of Ontario	Rob Helm	R. R. # 1 Tiverton, ON, N0G 2T0
Ontario Canola Growers' Association	Brad Martin	137 Inkerman St. W. Listowel, ON, N4W 1B8
Ontario Corn Producers' Association	Ken Hough	90 Woodlawn Rd. W. Guelph, ON, N1H 1B2
Ontario Corn Producers' Association	Larry Cowan	R.R. #1 Mount Brydges, ON, N0L 1W0
Ontario Corn Producers' Association	Don McCabe	R. R. # 1 Inwood, ON, N0N 1K0
Ontario Seed Corn Growers' Marketing Board	Dean Martin	2155 Smith Road, R.R. #5 Harrow, ON, N0R 1G0
Ontario Soybean Growers	Jay Robson	Box 1199 Chatham, ON, N7M 5L8 e-mail: mclean@soybean.on.ca
Ontario Soybean Growers	Matt McLean	Box 1199 Chatham, ON, N7M 5L8
Ontario Soil and crop Improvement Association	Leigh Cohoe	386105 New Durham Rd., R.R. #1 Burgessville, ON, N0J 1C0
Ontario Soil and crop Improvement Association	Keith Black	R.R. #1 Belgrave, ON, N0G 1E0
Ontario Wheat Producers' Marketing Board	Claire Sherk	R.R. #1 Cottam, ON, N0R 1B0
Ontario White Bean Growers	Larry Anderson	R.R. #3 Kent Bridge, ON, N0P 1V0
Ontario fruit and Vegetable Growers' Association	Jeff Wilson	R. R. #3 Orton, ON, N1K 1S5
Ontario Tender Fruit Producers' Marketing Board	Wayne Roberts	Box 100 Vineland Station, ON, L0R 2E0
Ontario Processing Vegetable	John Mumford	435 Consortium Crt.

Growers'		London, ON, N6E 2S8
Ontario Vegetation Management Association	Nancy Cain	5 Kingham Rd. Acton, ON, L7J 1S3
Observer	George Annette	BASF Canada Guelph, ON, N1G 2W9
Observer	Jim Shaw	Cargill Consulting Ridgetown, ON, N0P 2C0
Observer	Brian Legassicke	Monsanto Canada Inc. Cambridge, ON, N1R 1X6
Observer	Harold Wright	Syngenta Crop Protection Inc. Guelph, ON, N1G 4Z3
Observer	Paul Cowan	Syngenta Crop Protection Canada Inc. Plattsville, ON, N0J 1S0
Observer	Brad Smith	Syngenta Crop Protection Canada Inc. Guelph, ON, N1G 4Z3
Observer	Bryan Allen	Bryan Allen & Associates Newmarket, ON, L3Y 3W6

Membership:

ONTARIO FORAGE CROPS COMMITTEE
MEMBERSHIP OF CENTRAL AND SUB-COMMITTEES, 2002

Central Committee - eight members, four members nominated from each sub-committee

Mr. John Madill (P) **Chair (01-03)Kemptville College -UG**
Mr. Joel Bagg (P)Secretary (01-04)OMAFRA
TBA (P)
Mr. Bruce Whale (P) **OFC**
John Kinghorn (V) **OSCIA**
Mr. Jay Hackney (V) Comm. Plant Breeders
Ms. Donna Hancock (V) Plant Agr. UG
Mr. Chris Gillard (V) Ridgetown College-UG

Production Sub-Committee

Mr. Joel Bagg **(Chair 02-04)OMAFRA**
Mr. John Madill **Secretary 01-03Kemptville College-UG**
Mr. Jack Kyle **OMAFRA**
Dr. E. Ann Clark Crop Science, UG
Mr. John McGill CSGA
Mr. Murray Cochrane OSCIA
Mr. Bob Dippel **CSTA**
Mr. John Gibson (alt) **CSTA**
Dr. G. Roy AAFC, Kapuskasing

Mr. Bruce Whale OFC
Mr. Lloyd Kuhl — OCA
Mr. Jean-Guy Seguin DFO
Ms. Wendy Asbil — Kemptville College-UG
TBA — Environmental (if needed)

Variety Sub-Committee

Ms. Donna Hancock — Chair 00-03 Plant Agric. UG
Mr. Jim Johnson — Secretary (non voting)

Dr. Steve Bowley Plant Agr. U. of G.
Mr. Chris Gillard Ridgetown College-UG
Mr. John Madill Kemptville College-UG
Mr. Joel Bagg — OMAFRA
Mr. John Kinghorn OSCIA
Mr. Tim Welbanks — CSTA
Mr. Jay Hackney Commercial Plant Breeders
Mr. Barton MacLean — OFC
Mr. Matt. Bowman — NLARS-UG
Ms. Sher Bushell (observer) — Variety Reg'n, CFIA

OFCC Central Committee Membership- 2002

Mr. John Madill, Chair 2002 - 2004
Kemptville College, U of Guelph
Kemptville, ON K0G 1J0
Ph: (613) 258-8336 Fax:613-258-8401
jemadill@ca.inter.net

Mr. Joel Bagg, - Secretary 2001-2003 OMAFRA
322 Kent St. W.
Lindsay, Ontario. K9V 4T7
Ph:(705) 324-6125 Fx:(705) 324-1638
jbagg@omafra.gov.on.ca

Mr. Jay Hackney - Commercial Plant Breeders Rep.
Pickseed Canada Inc. ,1 Greenfield Rd. Lindsay, ON K9V 4S3
Ph: (705) 8789240 Fx: (705) 878-9249
jhackney@pickseed.com

Ms. Donna Hancock, U. of Guelph
Dept. Plant Agr., Crop Sci. Bldg.
Guelph, ON N1G 2W1
(519) 824-4120 x.8309 Fx:

dhancock@plant.uoguelph.ca
Mr. Chris Gillard, Ridgetown College
Ridgetown, ON N0P 2C0
Ph: (519) 674-1632
cgillard@ridgetownc.uoguelph.ca

Mr. Bruce Whale, Ontario Forage Council
Clovermead Farms R.R.# 2,
Alma, ON N0B 1A0
Ph: (519) 638-2230 Fx: (519) 638-5638
whale@wcl.on.ca

OFCC Production Sub-Committee Membership 2002

Mr. Joel Bagg, OMAFRA
322 Kent St. W.
Lindsay, ON K9V 4T7
Ph:(705) 324-6125 Fx:(705) 324-1638
jbagg@omafra.gov.on.ca

Mr. John Madill, Secretary 2002-2004
Kemptville College, U of Guelph
Kemptville, ON K0G 1J0
Ph: (613) 258-8336 Fax: 613-258-8401
jemadill@magi.com

Dr. E. Ann Clark, U. Of Guelph
Dept. Plant Agr., Crop Sci. Bldg.
Guelph, ON N1G 2W1
Ph: (519) 824-4120 ext.2508
annclark@plant.uoguelph.ca

Mr. Bruce Whale, Ontario Forage Council
Clovermead Farms
R.R.# 2, Alma,ON N0B 1A0
Ph: (519) 638-2230 Fx: (519) 638-5638
whale@wcl.on.ca

Mr. Murray Cochrane
Ontario Soil and Crop Improvement Assoc.
R. R. # 1, 222 Ansonia Road, Thessalon, Ontario P0R 1L0
Ph/fAX : 705-842-5622

Mr. Bob Dippel, Canadian Seed Trade Assoc.
Speare Seeds,

Box 171, Harristion, ON
Ph: (519) 338-3840 Fx: (519) 338-2510
spearese@wcl.on.ca

Mr. John Gibson, Canadian Seed Trade Association (alternate)
Growmark Inc. Box 634,
Mississauga, ON L5M 2C1
Ph: 905-890-8500 Fx: 905-890-4383

Dr. Gabriel Roy, AAFC
Kapuskasing Experimental Farm,
Box 160, Kapuskasing, ON P5N 2Y3
Ph:(705) 335-6148 Fx: (705) 337-6000
roygl@agr.gc.ca

Mr. Jean-Guy Seguin,
Dairy Farmers of Ontario
R.R.#1, Verner, ON P0H 2M0
Ph: (705) 594-9058

Mr. Lloyd Kuhl,
Ontario Cattlemens Association
R.R. # 2, Desboro, ON N0H 1K0
Ph:(519) 794-3081
lkuhl@bmts.com

Ms. Wendy Asbil,
Kemptville College, U. of Guelph
Kemptville, ON K0G 1J0
Ph: 613-258-8336
wasbill@kemptvillec.uoguelph.ca

Mr. Jack Kyle OMAFRA
322 Kent St. W.
Lindsay, ON K9V 4T7
Ph:(705) 324-6125 Fx:(705) 324-1638
jkyle@omafra.gov.0n.ca

TBA Environmental (if needed)

OFCC Variety Subcommittee Membership 2002

Ms. Donna Hancock, Chair, 2001-2003
Dept. Plant Agric., Crop Sci. Bldg.
U. of Guelph, Guelph, ON N1G 2W1
Ph: (519) 824-4120 Fx: (519) 763-8933
dhancock@plant.uoguelph.ca

Dr. Steve Bowley,
Dept. Plant Agric., Crop Sci. Bldg.
U of Guelph, Guelph, ON N1G 2W1
Ph: (519) 824-4120 Fx: (519) 763-8933
sbowley@plant.uoguelph.ca

Mr. Chris Gillard, Ridgetown College
Ridgetown, ON N0P 2C0
Ph: (519) 674-1632
cgillard@ridgetownc.uoguelph.ca

Mr. John Madill,
Kemptville College, U. of Guelph
Kemptville, ON K0G 1J0
Ph: (613) 258-8336 Fx: 613-258-8401
jemadill@magi.com

Mr. Joel Bagg, OMAFRA
322 Kent St. W.
Lindsay, ON K9V 4T7
Ph:(705) 324-6125 Fx:(705) 324-1638
jbagg@omafra.gov.on.ca

Mr. John Kinghorn
Ontario Soil and Crop Improvement Assoc.
1030 Cambray Road, R. R. # 3 Woodville Ontario K0M 2T0
Phone 705 374-4323
kinghornjrr3@nexicom.net

Mr. Jay Hackney - Commercial Plant Breeders Rep.
Pickseed Canada Inc.
1 Greenfield Rd. Lindsay, ON K9V 4S3
Ph: (705) 8789240 Fx: (705) 878-9249
jhackney@pickseed.com

Mr. Tim Welbanks, Canadian Seed Trade Association - Alternate
Pioneer Hi-Bred Ltd.

Box 730, Chatham, ON N7M 5L1
Ph:(800) 265-9435 Fx: (519) 436-6753
welbanks@phibred.com

Mr. Barton MacLean, Ontario Forage Council
R. R. #1 Napanee, Ontario
K7R 3K6
Phone (613) 354 2759
Fax (613) 354 1642
bmaclean@horizons.net

Ms. Sher Bushell, Observer
Canadian Food Inspection Agency
Plant Products Division, Variety Registration
59 Camelot Dr., Nepean, ON K1A 0Y9
Ph: (613) 225-2342 Fx: (613) 228-6629
sbushell@inspection.gc.ca

Mr. Jim Johnson - non voting secretary
ofcc@nti.sympatico.ca (Email preferred)
(705) 647-7160

MEMBERS OF THE FIELD CROP PEST MANAGEMENT SUBCOMMITTEE

February, 2001

NAME	ADDRESS & NUMBERS	
UNIVERSITY OF GUELPH		
Art Schaafsma	Ridgetown College University of Guelph Ridgetown, Ontario N0P 2C0 P - 519-674-1624 F - 519-674-1600 aschaafsma@ridgetownc.uoguelph.ca	(chair)
Greg Boland	University of Guelph 3234 Edmund C. Bovey Laboratory Building Guelph, Ontario N1G 2W1 P - 519-826-4120 ext 2755 F - gboland@uoguelph.ca	
Mark Sears	University of Guelph 1106 Edmund C. Bovey Administration Building Guelph, Ontario N1G 2W1 P - 519-826-4120 ext 3921 F - msears@evb.uoguelph.ca	
AGRICULTURE AND AGRI-FOOD CANADA		
Bruce Broadbent	Agriculture and Agri-Food Canada P - 519-457-1470 ext. 251 F - 519-457-3997 broadbentb@em.agr.ca	
Peter Mason	Agriculture and Agri-Food Canada P - 613-759-1908 F - masonp@em.agr.ca	
Paul Mailloux	Agriculture and Agri-Food Canada	
ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS		
Tracey Baute	Entomology Program Lead, Field Crops OMAFRA c/o Agronomy Building, Ridgetown College 120 Main St. East, Box 400 Ridgetown, Ontario N0P 2C0 P - 519-674-1696 F - 519-674-1564 tracey.baute@omafra.gov.on.ca	
Adam Hayes	Soil Management Specialist, Field Crops	

	OMAFRA c/o Agronomy Building, Ridgetown College 120 Main St. East, Box 400 Ridgetown, Ontario N0P 2C0 P - 519-674-1621 F - 519-674-1564 adam.hayes@omafra.gov.on.ca	
Albert Tenuta	Pathologist, Field Crops Program Lead OMAFRA c/o Agronomy Building, Ridgetown College 120 Main St. East, Box 400 Ridgetown, Ontario N0P 2C0 P - 519-674-1617 F - 519-674-1564 albert.tenuta@omafra.gov.on.ca	

Peter Johnson	Cereals Specialist OMAFRA 581 Huron St. Upper Stratford, Ontario N5A 5T8 P - 519-271-8180 F - 519-273-5278 peter.johnson@omafra.gov.on.ca	
Brian Hall	Alternate Production Systems Specialist OMAFRA 581 Huron St. Upper Stratford, Ontario N5A 5T8 P - 519-271-0083 F - 519-273-5278 brian.hall@omafra.gov.on.ca	
Horst Bohner	Soybean Specialist OMAFRA 581 Huron St. Upper Stratford, Ontario N5A 5T8 P - 519-271-5858 F - 519-273-5278 horst.bohner@omafra.gov.on.ca	
Brent Kennedy	Manager, Field Crops OMAFRA 3rd Floor S, 1 Stone Road West Guelph, Ontario N1G 4Y2 P - 519-826-3257 F - 519-826-3567 brent.kennedy@omafra.gov.on.ca	
Greg Stewart	Corn Industry Program Lead OMAFRA c/o University of Guelph Crop Science Bldg., Dept. of Plant Agriculture Guelph, Ontario N1G 2W1 P - 519-824-4120, ext. 4865 F - 519-763-8933 greg.stewart@omafra.gov.on.ca	
Hugh Martin	Organic Crop Production Program Lead OMAFRA 1st Floor NW, 1 Stone Road West	

	Guelph, Ontairo N1G 4Y2 P - 519-826-4587 F - 519-826-4964 hugh.martin@omafra.gov.on.ca	
Ian McDonald	Applied Research Co-ordinator, Field Crops OMAFRA c/o University of Guelph Crop Science Bldg., Dept. of Plant Agriculture Guelph, Ontario N1G 2W1 P - 519-8240-4120, ext. 6707 F - 519-763-8933 ian.mcdonald@omafra.gov.on.ca	
Jim Chaput	Minor Use Co-ordinator OMAFRA 1 Stone Road West, 3rd Floor Guelph, Ontario N1G 4Y2 P - 519-826-3539 F - 519 jim.chaput@omafra.gov.on.ca	

Kelly Ward	Product Development Specialist OMAFRA 1 Stone Road West, 3rd Floor Guelph, Ontario N1G 4Y2 P - 519-826-4094 F - 519- kelly.ward@omafra.gov.on.ca	
Gilles Quesnel	IPM Program Lead, Field Crops OMAFRA Box 2004, Concession Rd. Kemptville, Ontario K0G 1J0 P - 613-258-8250 F - 613-258-8392 gilles.quesnel@omafra.gov.on.ca	
Scott Banks	Emerging Crops Specialist OMAFRA Box 2004, Concession Rd. Kemptville, Ontario K0G 1J0 P - 613-258-8359 F - 613-258-8392 scott.banks@omafra.gov.on.ca	
Joel Bagg	Forage Specialist OMAFRA 322 Kent. St. West Lindsay, Ontario K9V 2Z9 P - 705-324-5856 F - 705-324-1638 joel.bagg@omafra.gov.on.ca	
ONTARIO MINISTRY OF THE ENVIRONMENT		
Doug Mewett	OMOE 135 St. Clair Ave. West, Suite 100 Toronto, Ontario M4V 1P5 P - 416-314-9235 F - 416-314-9237 doug.mewett@oeb.gov.on.ca	

COMMODITY ASSOCIATION MEMBERS		
Ken Hough	Ontario Corn Producers' Association 90 Woodlawn Rd. West Guelph, Ontario N1H 1B2 P - 519-837-1660 F - 519-837-1674 khough@ontariocorn.org	
Don McCabe	Ontario Corn Producers' Association R. R. # 1 Inwood, Ontario N0N 1K0 P - 519-844-2482 F - 519-844-2603 dmccabe@xcelco.on.ca	
Matt McLean	Ontario Soybean Growers' Marketing Board Box 1199 Chatham, Ontario N7M 5L8 P - 519-352-7730 F - 519-352-8983 mclean@soybean.on.ca	
Greg Devries	Ontario Soybean Growers' Marketing Board P - 519-683-4587 F - 519- gpdev@mnsi.net	
COMPANY REPRESENTATIVES		
Brian Woolley	Aventis CropScience Canada 578 Krug Street Kitchener, Ontario N2B 1L7 P - 905-854-4465 F - 905-854-4478 brian.woolley@aventis.com	
Wayne Barton	BASF Canada 9 Pamela Place Guelph, Ontario N1H 8C8 P - 519-637-3696 F - 519-637-3697 bartonw@basf.com	
Scott MacDonald	BASF Canada 9 Pamela Place Guelph, Ontario N1H 8C8 P - 519-824-2724 F - 519-824-5632 macdonsr@basf.com	
Luc Bourgeois	Bayer Inc. 23 Cedar St. Eden Mills, Ontario N0B 1P0 P - 519-856-2652 F - 519-856-9067 luc.bourgeois.b@bayer.com	
Leo Blydorp	Bayer Inc. 23 Cedar St. Eden Mills, Ontario N0B 1P0 P - 519-856-2652 F - 519-856-9067	

	leo.blydorp.b@bayer.com	
Nancy Desousa	Dow AgroSciences Canada Inc. 305 Consortium Court London, Ontario N6E 2S8 P - 519-681-0925 F - 519-681-4557 ndesousa@dow.com	
Al McFadden	Dow AgroSciences Canada Inc. 305 Consortium Court London, Ontario N6E 2S8 P - 519-681-0925 F - 519-681-4557 aggmcfadden@dow.com	
Rene Petroski	Dupont Canada Inc. Box 233 Streetsville Postal Station Mississauga, Ontario L5M 2J4 P - 905-821-5029 F - 905-821-5505	
Lesley Wright	Engage Agro Corp. 315 Woodlawn West Guelph, Ontario N1H 7K8 P - 519-826-7878 F - 519-826-7675 lpwright@attcanada.com	
Brenda Nailor	Engage Agro Corp. 315 Woodlawn West Guelph, Ontario N1H 7K8 P - 519-826-7878 F - 519-826-7675 brendanailor@engageagro.com	
Gabe Ferguson	Global Agricultural Business Enterprises Inc. 8192 Petrolia Line Alvinston, Ontario N0N 1A0 P - 519-847-5516 F - 519-847-5515 gabe@xcelco.on.ca	
John Gibson	Growmark Inc. 5600 Cancross Court Box 3020, Station A Mississauga, Ontario L5A 3A4 P - 905-826-0200 F - 905-814-4341 jgibson@growmark.com	
Tim Moyes	Gustafson Partnership 5-160 Research Lane Guelph, Ontario N1G 5B2 P - 519-767-3366 x 224 F - 519-767-9598 tmoyes@gustafson.com	

Edwin Pensaert	Gustafson Partnership #10-2712 37th Ave. N.E. Calgary, Alberta T1Y 5L3 P - 403-735-2505 F - pensaert@gustafson.com	
Louis Caron	Norac Concepts Inc. P. O. Box 62023 Orleans, Ontario K1C 7H8 P - 613-841-2907 F - 613-841-2908 lcaron@noraconcepts.com	
Harold Wright	Syngenta Crop Protection Canada Inc. 140 Research Lane Research Park, University of Guelph Guelph, Ontario N1G 4Z3 P - 519-836-5665 F - 519-823-0504 harold.wright@syngenta.com	
Wayne Bennett	Syngenta Crop Protection Canada Inc. 140 Research Lane Research Park, University of Guelph Guelph, Ontario N1G 4Z3 P - 519-836-5665 F - 519-823-0504 wayne.bennett@syngenta.com	
Jim Anderson	Syngenta Crop Protection Canada Inc. P - 519-878-7491 F - jim.m.anderson@syngenta.com	
Patty Turner	United Agri Products (UAP) 789 Donnybrook Drive, R. R. # 2 Dorchester, Ontario N0L 1G5 P - 1-800-265-4624 P - 519-268-8001 F - 519-268-8013 pturner@uap.ca	

Keith Lockhart	Uniroyal Chemical 440 Dorland Road Oakville, Ontario L6J 6B1 P - 416-616-8052 F - 905-845-0478 keith_lockhart@uniroyalchemical.com	
Richard Groen	Valent Biosciences Canada Ltd. 19 Wildan Dr., Box 19 Freelton, Ontario L0R 1K0 P - 905-659-0886 F - 905-659-0885 richard.groen@valent.com	